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COPPER STEAM PIPES.

THE explosion of a main steam pipe at the works of the London Electric Supply Corporation, at Deptford, on the 9th of April last, has been made the subject of a very interesting and valuable report by the Consultative Branch, Marine Department, of the Board of Trade. The matter has been mentioned in our columns at various times, and it will be remembered that the casualty resulted in the death of one poor fellow, and injuries more or less serious to nearly a dozen others. The pipe which gave way was a copper bend or elbow, which was introduced as a connection in the ordinary cast-iron piping, with a view to better provide for the effects of expansion in each range. The sheets having in the course of manufacture been shaped to form the two sides of the bend, the edges were thinned by hammering to form the scarf of the joint. The two parts were then drawn together and brazed, and, after planishing, the flanges were brazed on. The elbow, before leaving the works of the makers, was subjected to hydraulic pressure, and 360 lbs. per square inch does not appear to have caused any defect to exhibit itself.

That the questions of good workmanship and sufficient thickness of copper were not neglected is clearly shown by a mass of correspondence which passed between the builders of the engines and the firm which supplied the bends, but nevertheless their manufacture appears to have been carried out without any real knowledge of actual requirements, for a member of the firm which made the faulty connection said: "I do not know that we have ever made any tests of copper . . . . I have no data as to any pipe we may have tested to destruction." However, although nothing suspicious was detected in the outward appearance of the finished bend it failed through the brazing for a length of about 15 inches after having been subjected for some 4½ hours to a steam pressure varying from 45 lbs. to 152 lbs., at which point it gave way. The official report states that after the explosion the inferior quality of the workmanship was most evident. Considerable portions of both seams were very open, the spelter having run through, and the effective thickness of the metal at the fractured joint was reduced to about one-twelfth of an inch, although the copper should have been three times as thick, according to the maker's proposition. It is evident that in the process of brazing sufficient care was not exercised by the men engaged in the operation, and altogether this bend is considered, both as regards material and workmanship, as a very sorry specimen of its class. Three other bends, which were in position at the time, were afterwards tested under hydraulic pressure, and all failed to withstand the pressure which represented the *nominal* factor of safety.

The immediate cause of the explosion is believed to have been the presence of water in the range of piping, although it is extremely probable that the elbow would have failed eventually under the ordinary working pressure; nevertheless, the means for freeing the pipes of water are considered inadequate, and it is recommended that further provision should be made for draining. That there is something very unsatisfactory in the use of copper for such purposes is evident from a statement near the conclusion of the report, which runs as follows:—"Notwithstanding the many suggestions which have been made in view of the high pressures now employed, the question of means of obtaining reliable copper steam pipes is, I think, not yet satisfactorily solved." . . . "A firm is, I understand, about to lay down machinery with the intention of producing solid drawn pipes of considerable diameter; but if copper is liable to inherent defects, it is clear that this method of manufacture alone will not ensure sound pipes being produced." . . . "Other attempts have been made with a view to give greater confidence in the use of copper pipes, but these have not yet, I think, been subjected to sufficient trial to prove that they will meet the case."

It will be within the recollection of our readers that on June 14th last we published an article on the

"Elmore Copper Depositing Process," and some of the results obtained by Mr. Stepney Rawson were so extraordinary that it would almost appear that therein lies the solution of the important problem of obtaining reliable copper steam pipes. Perhaps, however, the official of the Board of Trade had this in his mind when penning the quotation last mentioned? The question is, without doubt, one of the greatest importance to users of steam power, and it is therefore of peculiar interest to electric light contractors; so perhaps Mr. Rawson, whose experience with tubes made by the Elmore process is very considerable, could give engineers a few words of encouragement and show that copper can be produced absolutely free from the hitherto inherent defects which are at all times difficult and occasionally impossible to detect?

LAST Saturday the cable connection with New Zealand was interrupted; thus we find that one of our great colonies is again cut off from communication with England. This cable was laid in 1876 at a cost, officially stated to be, of about £300,000, and 11 years later was offered for sale for £150,000; but this offer, however, was not accepted, as it was found that a new cable could be obtained for less than £150,000. As New Zealand is one of the colonies which is willing to assist in the establishment of the proposed cable across the Pacific, it did not require this interruption to indicate the necessity of duplicating telegraphic communication with Europe by a route more secure than that along which the present lines are laid.

IN another place we print a correspondence concerning a proposed "Direct cable from Hongkong to Singapore." As it is suggested that this cable should land on the territory of the British North Borneo Company, touching also at Labuan and Sarawak before reaching Singapore, it hardly merits the name of a "direct" cable. The manager in China of the Eastern Extension, Australasia and China Telegraph Company, when writing to the Colonial Secretary at Hongkong on the subject of the above cable, says, that "the existing cables are amply sufficient to carry a considerable increase of the present traffic," and goes on to point out, that, as "the additional traffic due to the establishment of the proposed new cable would be entirely insignificant in proportion to the large outlay, my directors instruct me to state that the extension could only be carried out in consideration of the undertaking being subsidised by the governments interested." Now, as the cost of these cables would be considerably over £400,000, it is not difficult to imagine the amount of the subsidy demanded to pay interest, working expenses, and sinking fund, on a cable whose value for commercial purposes would be infinitesimal in time of peace, and whose utility in war-time would be simply nil. To pay £30,000 or £40,000 per annum for such an unnecessary luxury as these cables strikes us as absurd in the extreme. The main advantage claimed for such a route is its political utility; but as for considerably over 1,000 miles of its length this cable would lie in water under 100 fathoms deep, it is obvious that in war-time an enemy could easily reap the advantage of what may be called an exclusively British manufacture, by picking up as much of this shallow-water cable as he might require and lay it in some other place where it would be more useful to him. Such a cable, from a political point of view, can only be looked on as reserve stock on which an enemy may draw as his needs dictate. It would be much wiser, and much more economical, to keep such a cable in a tank *in England;* the traffic might not be so great, but there would be the negative advantage that in war-time the cable could not be used against us by our adversaries.

AN important decision is announced in the *Electrical World* of the 3rd instant. The Commissioner of Patents has just rendered a decision in a case which, although not directly relating to an electrical invention, will, nevertheless, be of interest to electrical inventors. The Commissioner, we learn, affirms the decision of the Board of Examiners-in-Chief, and the Examiner of Interferences. The Commissioner, in his decision, says:—"It will be observed that an interval of nearly four years elapsed between the abandonment of the method claims of Beach's first application and the filing of the application involved in this interference, and that meanwhile Fowler had conceived the invention in controversy, reduced it to practice, entered upon the use of it in an extensive manner, applied for and obtained a patent, and that nearly a year had elapsed after the patent was published to the world before Beach filed the application now in controversy. That an abandoned application cannot of itself constitute a bar to a subsequently granted patent is abundantly established."

PROF. ANDREW JAMIESON'S report upon the Ajax patent single-acting gas engine, which is published in last week's *Engineer*, shows a remarkably good performance on the part of the motor. The tests, which seem to have been extra carefully conducted, prove it to be one of the most economical engines in the market. The brake dynamometer used was of the same kind as that employed in the now historical Society of Arts trials, and Prof. Jamieson gives it unstinted praise by declaring it to produce more satisfactory and uniform results than any other form of brake of which he is aware.

IN the *Engineer* for August 2nd, there appeared an article on "Engines for Electric Lighting Installations," referring to the choice of slow-going first-class engines made by Messrs. Hick, Hargreaves & Co., for the Deptford central station. Mr. Arthur Rigg, in a letter the next week, pointed out that anyone reading the article might conclude that the construction of a durable, economical, and trustworthy high-speed steam engine is a thing beyond the capacity of modern engineering. This, he wishes it to be understood, is quite at variance with his own opinions, and these naturally must be treated with respect. He is perfectly convinced that there is not the slightest difficulty in constructing steam engines of any power, to run with economy and uniformity at speeds suited to the requirements of dynamos for any length of time without necessitating more attention than that devoted to the larger slow-going engines. Because some high-speed motors have been made on imperfectly understood principles, and have failed to achieve results that nobody had any right to expect, it is neither sensible argument nor sound conclusion, says Mr. Rigg, to say that the thing is impossible.

WHETHER Mrs. Maybrick is guilty of causing the death of her husband or not, the *cause célèbre* in which she is the principal figure has given rise to a mass of correspondence in the daily Press which makes one tremble for the sanity of the human race. Opinions have been given, questions raised, theories started, and mawkish twaddle written *ad nauseam*, but nothing which we have hitherto seen compares in its shockingly bad taste with an advertisement emanating from an electropathic establishment which has often been spoken of in these pages. The paragraph in question is headed "The Maybrick Case," and advantage is taken of the public mind being now engrossed with speculating on the chances of a reprieve to warn hypochondriacs and nervous people that so called "pick-me-ups" and "tonics" are a source of danger, and that the best nerve tonic ever discovered is a mild continuous current of electricity applied by wearing one of Harness's electropathic belts! Further comments upon the depth to which some people may sink is surely needless.

IN the last issue of the *Electrical World* we see the following:—"The fact was long ago established that the resistance of the human body is variable under different conditions, but we were hardly prepared to see the interesting results obtained at the Edison laboratory, and given by Mr. Kennelly in another column. These would seem to show that, as a matter of fact, considerable uniformity exists in this matter. The actual measurement of over 200 persons of all sizes and ages showed the resistance from hand to hand to vary very little from the remarkably low value of 1,000 ohms. Naturally, the nature of the contact must be looked to to account for this; but, as Mr. Kennelly points out, it goes to prove that, far from being an uncertain quantity, the resistance of the human body is one which can be stated with considerable accuracy." Mr. Kennelly is quite correct, and Dr. Stone pointed out the same thing here several years ago. As electrical execution was not then the rage, the very interesting experiments of the English medical gentleman have probably been forgotten.

IT is a question whether the peculiar kind of journalism which flourishes in America, and which is now being submitted to the British public in the London edition of the *New York Herald*, is ever likely to take root here. For some time past an attack has been made upon the directors of the Underground Railway, who are taxed with selfishness and cupidity because they have not yet adopted electric traction in preference to steam. Whatever may be thought of this periodical as a purveyor of general news, it is evident to anybody that when it attempts to elucidate anything of a technical nature, its otherwise smart writers are sorely at fault. In a recent issue we see the following:—"The underground railways will be permitted, we fear, to keep up their noxious and disease-dealing channels until some great disaster, in the way of pestilence, or any unusual increase in the death rate, commands public attention." We would much like to know by what process of logical deduction the *New York Herald* arrives at the conclusion that the underground lines are pestilential? If the writer of the above absurdity would only take the trouble to consult statistics, he—or she, for it may be an old woman—would find that the health of the drivers and firemen on these lines compares most favourably with that of the men employed on any other railways in the United Kingdom. These are certainly the individuals who would be the first to suffer if the underground tunnels possessed the extraordinary properties above mentioned; while to passengers, although the fumes may be obnoxious during the time they are travelling over certain sections of the line, they are not deadly.

THE Fowler-Waring Cables Company is the title of a company the prospectus of which has been issued this week. The list of directors contains some good names, including those of William Fowler, chairman of John Fowler and Company, Limited; Walter Chamberlain, of Harborne Hall, Birmingham; the Hon. J. S. Gathorne-Hardy, M.P., director of Low Moor Company, Limited; Col. J. T. North, Eltham, Kent; beside those of Mr. R. W. Eddison, well known in connection with the Tatham cable business, and Mr. R. S. Waring, the inventor of the underground wires bearing his name, to whose excellent insulating properties Sir William Thomson, Mr. Preece, and others testify. The field of operation for the above company is very extensive, and with such a directorate good results should be obtained. It must not be forgotten, however, that there are two or three other manufacturers who make lead-covered cables, and whose cables have stood the time test (the only one worth anything) to a far greater extent than those of the new company. In this connection the sale price is a matter worthy of consideration, and we cannot help the feeling that the price (£41,000) to be paid, nearly all in cash and the balance, comprising the whole of the founders' shares, is too high. It would have been well if Messrs. Cooper Brothers & Co., the chartered accountants, could have seen their way to give the amounts of the sales in both periods of six months mentioned by them; as their letter stands it means very little. With the exception of the few points to which we have felt it our duty to call attention, we see no fault to find with the prospectus. The cables are good, the directorate strong, and with proper management a considerable business should be effected, and it has our hearty wishes for a prosperous and profitable future.

A MEETING of the Executive Council of the International Exhibition of Electrical Engineering, General Inventions and Industries (Edinburgh) was held in the rooms at 40, Frederick Street, Edinburgh, on Wednesday. The ground available for exhibition purposes at Merchiston has been finally fixed upon, and arrangements made with the proprietors and farm tenants. It extends from Gray's Loan, and embraces fields on either side of the Union Canal, near the railway terminus at Colinton Road. It also extends to the westward across the suburban railway line, and if necessary, upwards of 75 acres can be had to the west of the suburban line. The greater portion of this land being in grass, will be available for athletic sports. It was also reported that, notwithstanding the absence of many citizens from home, the guarantee fund already amounts to upwards of £10,000. The Executive Council expressed their hearty approval of the progress so far, and it was agreed to push forward the work. A letter was read from Mr. S. Lee Bapty, the general manager, stating that he would have the draft prospectus and report on space arrangements ready early next week. It was agreed also that the plans of the Exhibition buildings be thrown open to competition, and the matter was remitted to the Buildings' Committee to report upon.

TELEGRAPHY REGARDED FROM A FINANCIAL POINT OF VIEW. (HIGH SPEED AND LOW SPEED.)

IT is now notoriously admitted by everyone that telegraphy, along with its undeniable political and moral aspect, has also a financial side not less evident.

As a public service its mission is to furnish a trustworthy instrument for the prompt exchange of ideas and to render its means of communication available for the mass of the public. It is important that the country should be able to make use of the telegraph to the utmost limit of possibility, the increase of the number of telegrams contributing incontestably in no small degree to the development of national prosperity.

As an industry, the fundamental point to be reached is to bring in the greatest profit. But in a great number of countries the telegraph, far from yielding a profit, does not cover expenses. What means can be employed to remedy this situation? Shall the price of telegrams be increased?

To demonstrate the slight efficacy of a rise of charges, I will confine myself to a single instance, but which, I hope, will be considered decisive.

Conjointly with the adoption of the scheme of charging per word, the cost of internal telegrams in Switzerland has been raised to such a point that the mean returns per dispatch which, prior to October 1st, 1877, were 55 centimes during the three first months of the innovation rose to 71 centimes, or an increase of 16 centimes. But as we learn from the Report of the Administration of the Swiss Telegraphs on its working in 1877 it was expected that the average number of words, which was still 16·24, would gradually sink to 14, whence there would result only the modest increase of 10 centimes per telegram.

The following table indicates the financial results of working according to official data published up to this day :—

Years.	Number of telegrams.	Difference from 1876.	Returns.	Difference from 1876.
1876	2,118,373	...	1,164,513	...
1877	1,950,546	– 167,827	1,138,366	– 26,147
1878	1,590,108	– 528,265	1,100,404	– 64,109
1879	1,679,831	– 438,542	1,158,684	– 5,829
1880	1,751,018	– 367,355	1,202,447	+ 37,934
1881	1,837,385	– 280,988	1,221,061	+ 56,548
1882	1,790,311	– 328,062	1,191,556	+ 27,043
1883	1,750,045	– 368,328	1,137,050	– 27,463
1884	1,724,989	– 393,384	1,116,667	– 47,846
1885	1,759,054	– 359,319	1,138,507	– 26,006
1886	1,793,938	– 324,435	1,159,083	– 5,430
1887	1,816,524	– 301,849	1,177,107	+ 12,594
Total since 1878	17,493,203	–3,690,527	11,602,566	– 42,564

If we suppose that with the maintenance of the old scale of charges the internal tariff of the Swiss offices, the number of which has increased by more that 300 from 1876 to 1887, had merely reached each year the figure shown in 1876, we should have had in the decennial period 1878—1887 21,188,730 telegrams, yielding 11,645,130 francs or 3,690,000 telegrams and a return of 82,500 francs in excess of what has taken place.

In 1876, the number of telegrams exchanged with foreign countries, the international correspondence at the end of the ten years period would be 5,876,700 telegrams. But there have been in reality 8,214,211; that is to say, 2,337,000 in excess. Thus, whilst on the one hand the home correspondence, as compared with 1876, shows a decrease of 14 per cent., the foreign correspondence, on the other hand, has increased by 71 per cent.

II.—The increase of charges not giving the result expected, let us see if by a reduction of the price of telegrams we might prepare budgets which should show a favourable balance.

The partisans of this measure ask why, if we wish to extend the use of the telegraph and make of it an excellent source of revenue for the Treasury, we do not do with it as we have done with the post, since the decrease of postage to a uniform and very trifling sum has yielded such happy results.

To this observation, which was made at the Telegraphic Conference which sat at Berlin in 1885, the Italian delegate, Sen. D'Amico, replied: The post can double its traffic with a slight increase of outlay, whilst in the telegraph a small increase of dispatches would suffice to require new wires, new apparatus, and new officials.

Such is the fact. The post both in point of time and of material transmits a thousand, ten thousand, fifty thousand letters as easily as a hundred. The whole goes off in the same train. But the telegraph can, generally speaking, only forward one dispatch at a time and must be equipped on a vast scale to be in a position to preserve a reasonable mean speed for correspondence. Hence, an increase of traffic may sometimes involve an increase in the facilities for working, sometimes in a very rapid proportion. Under these circumstances we must use circumspection in estimating the increase of profit which would result from an influx of telegrams.

Still we cannot deny that the telegraphic systems in general have still on their lines a very fair margin. If we examine tables showing the occupation of the lines, we discover everywhere blank intervals in their working in the main lines as well as in those of an inferior order. Thus it is evident that all the wires are capable of a greater sum total of work. But the increase of work should not be produced at hours of the day when the lines are already sufficiently engaged.

Save this reservation, there is still more than one stage to be traversed before the transmitting power of the net is carried to the maximum, which is the basis upon which rests all the economy of the telegraphic service.

This leads us in the third place to the examination of the means indicated as leading to the desired solution.

III.—The means which, in my opinion, whilst developing the traffic would increase the returns, and the application of which would direct the institution towards its double object, consists in the classification of the dispatches under three heads :—

1. Telegrams for accelerated transmission (urgent telegrams) to be sent in preference to dispatches of the following class.

2. Telegrams for normal transmission.

3. Telegrams at low speed (with a reduction of price) to be sent after the dispatches of the second class have been finished.

We may first note that with the exception of the four following States, Great Britain, Bulgaria, Norway, and Switzerland "urgent telegrams" are already admitted in European relations, and let us observe that these full speed correspondences, the utility of which is duly recognised, do not come in in such numbers that their treatment can sensibly affect the rapidity of transmission of ordinary telegrams. Further, if the number of the former increased so as to become an obstacle to the free disposal of the general correspondence, the extra fees which would be charged would largely contribute to the expenses of laying down and operating new wires, and apparatus for multiple transmission where the want was felt.

The telegram of the third class (low speed) which would be the complement of the urgency telegrams (high speed) has not yet made its appearance in Europe.

I have shown elsewhere what might be expected from a reduction of charges for correspondence which might undergo a delay in transmission without running the risk of failing in their object. These telegrams would be numerous, seeing that there are thousands of circumstances in life in which the telegraph would be utilised, to get rid of small epistolary jobs which generally cost more time than we care to devote to them. And as the transmission of slow telegrams might be effected at moments when at present the wires are unoccupied without increasing the outlay the profits would accrue to the Treasury.

On the lines which are now idle for the greatest part of the day, the creation of a class of cheap telegrams between the offices on such lines would be equivalent to a general reduction of charges, and the results which might be involved would not necessitate any increase in the means of transmission.

Here are a few figures which show what gaps still exist in the working of the lines. Among 387 Dutch offices there were in 1887, 134 which, on the average, sent out only five telegrams daily; in 1886 in Switzerland among the 1,222 offices, there were 1,062 which sent out less than 10 telegrams daily, and 159 with less than one telegram daily. And it will be something similar everywhere.

It is evident that where there exists a wire, an apparatus and an official, the tariff which lets all these elements of production stand idle instead of keeping them employed has something wanting, for work alone yields receipts, and the expenses go on always whether the line works or stands idle.

Hence it follows that in searching for measures which would lead to a maximum employment of the wires it is proper to follow the advice of economical science, which, if applied to telegraphy, declares that *within the limits of the organisation of the lines* it is more profitable to transmit despatches cheaply than not to transmit them at all. We may differ as to the method of applying this principle, but it is nevertheless the only one which remains applicable, industrially speaking.

From the moment when we recognise that telegraphy contains the commercial element, we have only to follow the track which the nature of the case has distinctly proved, and introduce measures which free trade would not for a moment hesitate to apply.

After having contended that if the end proposed is to render telegraphy available to more persons, and to make of it, if possible, at the same time a source of revenue, M. E. Cuper asserts that we must look for inspiration to commerce, to the great industries, to companies. In developing this idea, he adds:—

"On railways are not there transports of goods by swift and slow trains? Are there not express trains, direct, semi-direct, and 'omnibus trains,' which everyone is free to use, according as he is more or less pressed for time? By the express and direct trains only the great centres are placed in communication, and for some hours the other towns situate along the line are as if non-existent. Why are not 'omnibus trains' the only ones in existence, seeing that they are the only ones which can, for financial reasons, be utilised by everyone? In one and the same train are there not often first, second, and third class carriages? Certainly the first class does not arrive sooner than the third, and this division merely gives the traveller the option of seating himself more or less comfortably, and of spending only what he wishes, or what he can. Can he not even, if needful, have a special train?

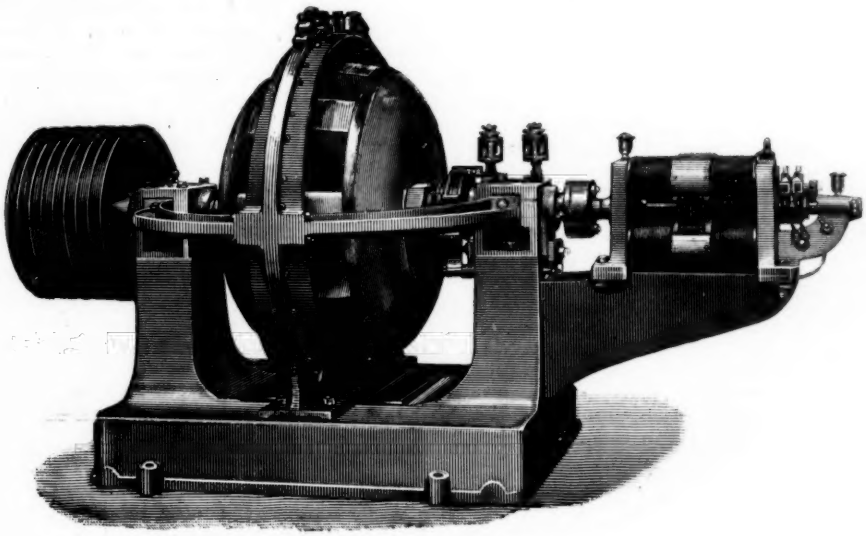
"All these distinctions, based upon advantage and free choice, are a means of connection more certain than would be absolute uniformity.

"The post itself, has it not registered letters, the carriage of which is certainly not more rapid, but the delivery is more certain? In a word, take all the great undertakings which affect the public, and you find various grades of price uniformly varied."

IV.—After having explained the different grades of urgency for telegrams, it remains merely to show the advantages of the system proposed. These advantages would appear:—

1. In an increased transmission power of the system of wires, by leaving to the last place the transmission of telegrams which will bear delay, we should enlarge the means of action for business hours, which would enable us, without additional expense in wages, to increase the total number of transmissions effected on the totality of the lines in a given time.

2. By a development of the traffic in consequence of the reduction of charge for slow telegrams.



THE MORDEY-VICTORIA ALTERNATOR.

Thus regarding the situation which would be created, we may consider the innovation useful, since it would postpone the time when additional means of transmission would be needed. It would lead to the full utilisation of the resources of the wires.

P. G. H. LINCKENS,

Commissioner in the General Direction of Dutch Posts and Telegraphs.

Journal des Economistes, July, 1889.

THE MORDEY-VICTORIA ALTERNATOR.

THE illustration represents the Mordey-Victoria alternator with direct-driven Victoria exciter, the latter being larger than is necessary, and, indeed, capable of exciting two such machines.

This apparatus is one of the same size as those which we recently had an opportunity of seeing run in parallel and as alternate current motors in the works of the Anglo-American Brush Corporation, as illustrating a portion of the paper on alternate current working read before the Institution of Electrical Engineers in May last.

The normal speed of the machine is 650 revolutions, and the output 37,500 watts or 50 electrical H.P. as generator, or 50 H.P. as an alternate current motor.

The excitation of this machine is comparatively small; 500 watts only are required for this purpose at full load, and rather less with lighter loads.

One point to which in this machine attention should be drawn is the very small waste of power that takes place when the machine is run on open circuit or with a small output. When excited to give the full electromotive force at full speed, but with no external load, it requires only 3 H.P.

This is a point of very great importance, for it is sometimes necessary to run alternators for a considerable portion of the day with a very small load indeed, and it is desirable that when so running the absorption of power should be as small as possible.

The commercial efficiency of the machine with full load is quite 90 per cent.

There are some differences in details when compared with the first machine of this type, which we described in our columns about a year ago, the modifications being such as to add to the mechanical stability of the machine.

The copper sheath, which was previously used to cover the revolving magnet for the prevention of disturbance of the air, has been replaced by an iron sheath, cast in one with the magnet itself.

The exciter is an ordinary type Victoria machine, which, for convenience, is mounted directly on the shaft.

ELECTRIC LIGHTING IN ALGERIA.

THE utilisation of water power as a cheap mode of producing electricity both for light and power purposes has at different times been advocated in this journal; but somehow or other very little, if any, progress appears to be made here. Excellent examples of such installations have been placed under our notice by both American and Continental electrical engineers, and we have now to record a project which is about to be carried out in the town of Orléansville, Algeria. A concession has been granted to Messrs. Gally and Daloz, electrical engineers of Paris, for both the public and private lighting of the town in question. A central station will be established, and this will be divided into two parts. The first will consist of hydraulic works, located about 3¾ miles distant from Orléansville, where there is a plentiful supply of water power. The plant there will comprise a 70 H.P. turbine, with horizontal axis, and two dynamos of 500 volts pressure and 35 ampères. In the second part, or the central station proper, there will be placed a Babcock and Wilcox tubular boiler, and a steam engine of the Weyher and Richemond type. There will also be erected a Desroziers-Bréguet dynamo of 250 ampères at 110 volts pressure, and 350 pairs of Planté accumulators. During the daytime the accumulators will be connected in series, and charged by a current of 35 ampères from the hydraulic works, the current being transmitted by properly insulated copper cables. At night the accumulators will be placed in series for serving the district. The steam engine and dynamo in the station are kept as reserve, in case the supply of water should fail. The distribution of current will be effected by naked copper wires, and the town will be lighted by 250 lamps of 16 C.P., suspended from lamp-posts in the streets. Provision has, however, been made for a future extension of the capacity of the station to 600 lights.

ELECTRIC BRIDGES AT THE PARIS EXHIBITION.

AN interesting paper was recently read before the Société d'Encouragement in Paris by M. Mégy, a French engineer, regarding the overhead electric movable bridges in the Paris Exhibition. These bridges, which are two in number, are located in the machinery hall, which is about 460 yards long by 125 yards wide, and which is divided by a large central avenue into two symmetrical parts. Here are installed the machinery and apparatus, above which the two electric bridges move. The primary object of these bridges, which were erected conjointly by MM. Bon and Lustrement on the one hand, and by MM. Mégy, Echeverria, and Bazan on the other, was to assist in the installing of the machinery in the gallery, and also at the close of the Exhibition to aid in the taking down of the machinery. The idea, however, was conceived of utilising the bridges as a kind of overhead railway, the distance traversed by them being about 435 yards. The idea was carried out, and the bridges have for some time past been employed for conveying passengers desiring to have a good view of the exhibits in the hall over the whole length of the journey. The bridges are moved by electricity, and their general installation, according to M. Mégy, is as follows:—

"There is a central station containing a boiler, the motors and dynamos producing the energy, which is conducted to each of the bridges by two conductors laid along what may be termed the track. This consists of two trellis girders placed about 23 feet from the ground and about 58 feet apart. The girders are supported by a double row of cast iron columns, which also serve as supports for the hanging 'chairs.' There is a departure station for passengers at each end of the two lines. The station platforms, which are level with the lines, are reached from the ground by means of a staircase and hydraulic lift at each station. Of the two bridges, that constructed by MM. Mégy, Echeverria, and Bazan is situated at the side of the Ecole Militaire, whilst the other is on the opposite side. They occupy an area of 100 square metres, of which about 90 are available for passengers, the capacity being for 50 persons. The motive power for MM. Bon and Lustrement's bridge is given to its mechanism by a Gramme motor, whilst for the other a Mist dynamo is employed. The bridge of the former is operated by means of friction plates and friction cones, an endless screw and other gearing. MM. Mégy and Co.'s bridge is worked by simple gearing with the aid of the elastic engaging gear of the Mégy system."

ELECTRIC LIGHTING v. GAS.

THE half-yearly meeting of the Gas Light and Coke Company was held last Friday at the offices, Horseferry Road, Westminster, Colonel Makins, M.P., presiding.

The report of the directors contained the following among other paragraphs:—

"The attention of the proprietors will no doubt have been drawn to the recent public enquiry on the subject of a supply of electric lighting for London, and to the numerous applications for statutory powers now being proceeded with by electric lighting companies, founded upon the report to the Board of Trade made by Major Marindin. The directors having failed to obtain adequate protection for the safety of their mains in the provisional orders brought before the House of Commons, it became necessary to oppose the Confirmation Bills submitted to Parliament. The opposition resulted in the insertion, in all the Bills, of special clauses giving the company the protection required.

"Public attention has also been widely drawn, during the past six months, to the launching of water gas companies, and some few proprietors have manifested anxiety at the possibility of another competitor with coal gas for general lighting. The company's chief engineer is now engaged in experiments to test the value of water gas as an adjunct to the company's present manufacture, with a view to its utilisation should it be proved to be efficient and economical. Water gas in itself is not suitable for lighting purposes, but must be used in connection with some illuminating medium. When enriched and otherwise dealt with it can be used as an illuminant, and is so used in America and other places where coal is costly.

"The directors view the threatened competition of

the whole of these companies without alarm. London, at the present day, contains upwards of 550,000 houses, more than half of which are still unsupplied with gas, and are, to a great extent, situated in such localities as are unlikely ever to become attractive to the promoters of more costly luminants. The directors are actively pushing the company's trade in these districts, and are introducing into the dwellings of the working classes the advantages of heating and motive power, ventilation, and light, by means of coal gas, on conditions of payment which are within the means of the poorest."

The CHAIRMAN stated that their increased business was most satisfactory, and so far as they could judge they had not been at all adversely affected by the increase in the electric light which had no doubt also taken place. The number of users of electric light in their district had gone up from 508 to 581—an increase of 73, and there was of course rather more than a proportionate increase in the number of lights used. But after all that was a mere bagatelle, and whether the increase was a large or a small one it had not had any prejudicial effect upon the company's existing business, and was not likely to have much prejudicial effect on the future increase in the company's business. The question of electric lighting and of water gas was one that grew smaller rather than larger the more they inquired into it. In fact, when they came to close quarters with the new systems of light they always found two or three rather serious drawbacks and difficulties to be overcome. Their rate of progression would be somewhat the same as was the case with the gas companies many years ago, and it would take a good number of years before they reached a state of prosperity.

Sir GEORGE RAWLINSON also referred to the question of electric lighting, and said they might take it that as the rich were to the poor so would be the proportion of electric lighting to gas lighting. They could not stop it, but it was a luxury, and it would be only used as a luxury. They need not be in the slightest fear about it, but even if they did have any fear they could not prevent it.

THE K.M.B. POCKET GALVANOMETER.

THIS patented instrument, introduced by Messrs. King, Mendham & Co., of Bristol, is intended for those who require a small measuring galvanometer, that can be carried in the pocket and be used on every occasion for testing with currents up to one ampère. It is therefore so designed, that while it can be used as a practical instrument for simple line and battery testing, it can also be used for the absolute measurement of currents. With the dial in one position, tests can be made of line wire for continuity or of the battery for approximate efficiency; with the dial turned half round so as to bring the lower half uppermost, each individual cell can be tested for strength of current, and a faulty cell easily detected and removed from the battery.

FIG. 1.

FIG. 2.

The galvanometer is made in two distinct parts and in this construction consists its novelty; the front portion carries the magnetic needle and graduated dial and is capable of rotation round its centre, its edge being milled to admit of easy movement; the back part or case contains the bobbins, which are wound with copper wire to two measured resistances, and in front of these bobbins the needle swings. One half of the dial is graduated in degrees while the other portion represents an equally divided ampère, and the dial may be rotated so as to bring either half uppermost, the

FIG. 3.

needle, of course, remaining in a vertical position. That part of the dial graduated in degrees should be used uppermost when it is required merely to test a line wire or a battery, as with an ordinary detector galvanometer; the other portion of the dial should be used uppermost when it is desired to find the strength of the current given by any one individual cell, this is indicated in milliampères and the instrument will measure currents up to 1,000 milliampères or one ampère.

In fig. 1 the instrument is shown with its two graduations, that part divided into degrees being uppermost.

Galvanometers are also supplied in cases, as shown in fig. 2, which is so arranged that the vertical portion against which the instrument is fixed is removable, and fits down into the tray, which gives it the protection it requires; the galvanometer can thus be carried in the tool bag without fear of being damaged, and tests can be very easily and conveniently made by means of the terminals in the case. Another method adopted for mounting the galvanometer is represented in fig. 3, and so mounted it can be used as a laboratory galvanometer, connections with the terminals being made through the stem.

ON THE EFFECT OF PLACING A BALL AND POINT IN A HIGH TENSION ALTERNATING CURRENT CIRCUIT.*

G. L. TEEPLE and W. K. ARCHBOLD.

THE work was undertaken in order to investigate a peculiar phenomenon which seems to have been first observed by Mr. E. G. Acheson, of the Standard Underground Cable Company, at Pittsburgh. He had described it as follows:—If a ball and a point be connected one to each pole of a source of alternating E.M.F., and also to the terminals of a galvanometer, a deflection as if from a straight current will be observed in the galvanometer.

It was found that, to get the effect, a high E.M.F. was necessary, and that the point must be brought so close to the ball that an arc forms between the two, and this arc drawn out to a certain length, depending on the E.M.F. used and on the resistance in the galvanometer circuit. The arc was shown to be intermittent, corresponding with the alternations, and to conduct apparently much more readily from the point to the ball, than vice versa, so that a very large excess of total current is in the direction from point to ball. A galvanometer placed directly in series with such a ball and point would show, therefore, a marked deflection. The currents used were very small. At present no exact ideas of their size can be given.

Several sets of curves were obtained showing the

* Abstract of Thesis.—Cornell *Crank*.

variation of E.M.F. between ball and point, with small increments of time during a complete wave, both with and without the arc. They verified one another, and showed that as the point came to its highest positive potential the arc suddenly formed, and the potential difference between ball and point immediately dropped to a very low value, and remained there for about one-third of a complete wave, when the arc broke and the potential suddenly changed sign, jumping to its maximum value the other way. No arc forms from ball to point. The curve of total current showed a very large excess of area on one side, as has been before explained. The investigation has been one of a good deal of difficulty, and has brought out one of the very few known differences in the behaviour of the two "poles" of an electric current.

THE BIRMINGHAM EXHIBITION.

AMONGST the novelties at this exhibition, certainly the most interesting, if not also the most important, is

The Snelgrove Electric Weighing Machine.

This machine, which is now exhibited in England for the first time, is the invention of Mr. Wm. Snelgrove, experimental engineer to the exhibitors, Messrs. W. and T. Avery. It may be generally described as a self-balancing, self-indicating lever weighing machine, and apart, therefore, from the fact that it embodies the first application of electricity to the control of a weighing machine, may be said to be unique, being, in fact, the first and only self-indicating knife-edged machine in the world. The lever weighing machine, with knife-edged centres, has long been recognised by engineers as the only truly accurate form of apparatus for weighing. In recent years, however, a considerable demand has arisen for self-indicating dial machines, and various forms of spring balances, pendulum balances, hydrostatic or hydraulic weighing machines, &c., have been produced to meet this demand.

In all these machines, although their general convenience has ensured them many users, they have never been able to supplant the lever machine where accuracy was the first essential. In the heavier classes of platform weighing machines and weighbridges the lever principle only is universally used.

A weighing machine that should combine the accuracy of the lever construction with the self-indicating advantages of the spring balance has hitherto been sought for in vain by weighing machine makers, but the problem has been solved in the Snelgrove weighing machine by the aid of electricity.

The whole of the mechanism for balancing the machine and indicating the weights being confined to the steelyard or beam, the latter only is shown in the illustration, and it must be understood that in all other details the machine is of the ordinary platform or weighbridge type, the machine illustrated being mounted on a suitable pillar, and the back centres connected as usual by a shackle and link to the lower levers carrying the platform.

The Snelgrove electric weighing machine shown in the illustration is now on view at Messrs. W. and T. Avery's stand at the Electrical Exhibition, Birmingham. It indicates, by means of revolving dials, up to 10 cwt., by graduations of 1 lb., the weights being shown through the three windows showing cwts., qrs., lbs., respectively.

There are at the present time two similar machines on view at Messrs. W. and T. Avery's stand at the Paris Exhibition, one of a capacity of 20,000 kilos. indicated by 2 kilos., the other of a capacity of 500 kilos. by ½ kilo. In the French machine units, tens, hundreds, and thousands of kilos. are shown, and in the English pattern cwts., qrs., lbs., the result being in either case read at a glance.

The machine under notice has two movable slides or poises, the small poise being equivalent to 27 lbs., and giving 27 indications of 1 lb. each, and the large poise being equivalent to 9 cwt. 3 qrs. and giving 39 indications of 1 quarter cwt. each, one step or indication of the heavy poise being equal to the entire travel of the small poise.

Each poise is provided with wheels or rollers at both ends, the large poise travelling on the steelyard and the small poise travelling on rails attached to the steelyard. Each poise is cut with ratchet teeth on the upper and ordinary spur teeth on the lower sides.

The ratchet teeth, whose vertical sides face the zero end of the steelyard, engage with pawls pivotted on the frame work of the machine, the lower racks gearing into independent loose pinions fitted with clutch boxes sliding on a main spindle. The spindle is revolved by a small electro-motor, and is provided with one fixed clutch box with two clutch faces in close proximity to the loose pinions and clutches.

Electro-magnets are arranged to lift the pawls, and other electro-magnets are provided to pull the loose clutch boxes in and out of gear with those fixed on the spindle. Springs are also fitted to pull the clutches out when the said magnets are demagnetised.

At both extremities of the travel of each poise current switches are arranged to be operated by the poise itself. The outward movement of the poises is effected by the electro-motor, the inward movement or return to zero by means of helical springs which are coiled up during the outward travel of the poises.

Electrical contacts are fixed on the upper and lower jaw of the carrier and on the free end of steelyard, which is free to move between the said jaws.

One pole of a battery is connected to both jaws of the carrier, the other pole, by means of a flexible conductor, to a terminal near the centres of the steelyard. The electro-motor and the clutch-withdrawing magnets are included in the circuit of a second battery, connected by terminals and a flexible cord near the centres.

The carrier is provided with an electro-magnetic brake in circuit with the carrier contacts to check undue vibration of the steelyard, and without affecting or impairing the sensitiveness of the balance to stop the vibrations, after equilibrium has been attained.

The second battery circuit including the electro-motor, is normally open, but is closed by means of an electro-magnet switch included in a circuit from the upper steelyard contact only.

When the steelyard is resting on the lower jaw of carrier, the first battery is in circuit with the pawl-lifting magnets, and the motor battery circuit is open. With the steelyard against the upper jaw, the first battery is in circuit with the clutch-operating magnets and the motor battery circuit is closed. With the steelyard in equilibrium or all the poises at zero, or at the further extreme limit of their travel, both battery circuits are open, and the machine comes to rest.

The action of the machine is as follows:—On the load being placed on the platform the steelyard rises, and presses against the upper end of steelyard carrier and thus closes a circuit of one battery. Included in this circuit is the brake electro-magnet, the motor relay, the switch, and the small poise clutch-magnet; the motor therefore starts, and the small poise being drawn into gear with the main revolving spindle, travels out on the steelyard until (unless it previously balances the load) it strikes the switch lever; the small poise clutch magnet is thereby cut out of circuit, and the large poise clutch magnet is included instead. The small poise being released from the clutch, would now travel back to zero, propelled by its helical spring, but it is held in its outward position by its pawl. The large poise is now travelling out on the steelyard until (unless it previously balances the load) it strikes its own switch lever, thereby cutting its own clutch magnet out of the circuit.

Thus, should the load on the platform exceed the capacity of the machine, all the circuits are broken and the whole of the mechanism comes to rest. Supposing, however, that the platform load is balanced on the large poise, reaching a certain point in its travel, the

action of the machine will be as follows :—On the load being balanced, the steelyard will fall away from the upper contact, thereby breaking the circuit completely at that point. The clutch magnets of the large poise and the motor relay will be demagnetised, the motor relay armature springing back into normal position,

In this position it will have either exactly balanced or over-balanced the platform, in the former case nothing further need be said except that the figured dials will indicate at a glance the exact weight on the platform.

The poise may, however, be said to have over balanced

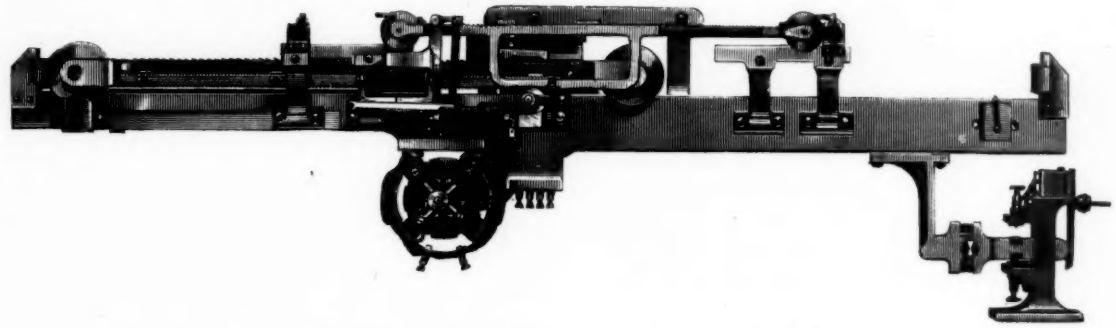


FIG. 1.—FRONT VIEW, WITH BEARINGS AND CENTRES AND DIALS REMOVED.

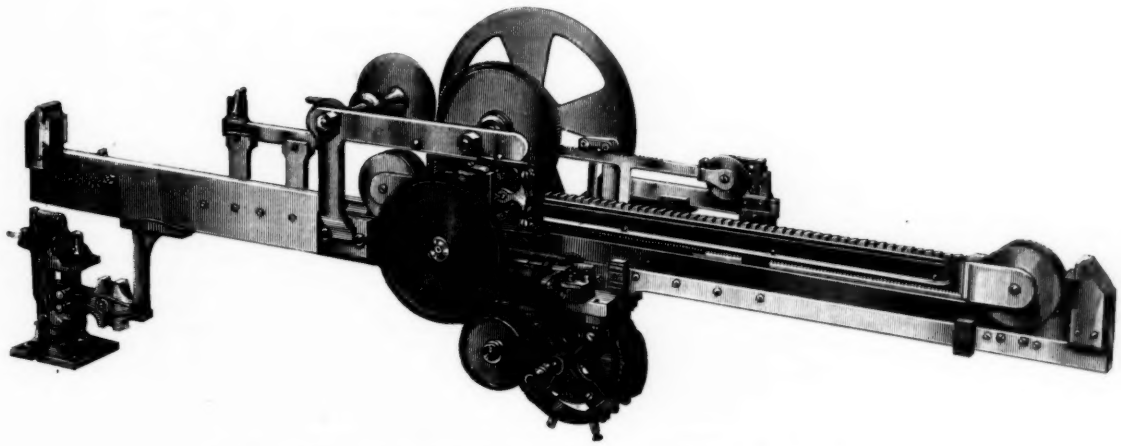


FIG. 2.—BACK VIEW (INCLUDING DIAL) WITH BEARINGS AND CENTRES REMOVED.

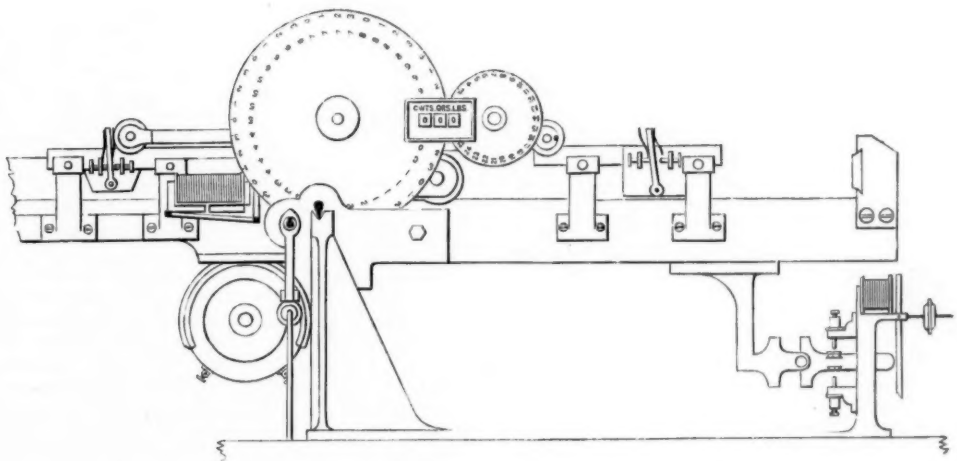


FIG. 3.—FRONT VIEW (REAR END SHORTENED) SHOWING DIAL, KNIFE-EDGED CENTRES AND BEARINGS.

cuts the motor out of circuit and for a short period passes the current of the motor battery through the clutch-withdrawing magnet of the large poise. The large poise is now released from the motor and (although the latter may continue to run by momentum for some seconds) is instantly stopped and held by its pawl, against its return spring.

the load (in 99 cases out of 100 this will be the case), consequently the steelyard will drop from the upper and rest on the lower contact screw of the end carrier. A battery circuit will then be closed, including the brake on the end carrier, small poise, rear switch, and the small poise pawl magnet. The latter will then lift the pawl, and the small poise will then run back

until by balancing the load the free end of steelyard rises from the lower contact. The instant the steelyard rises into equilibrium, the pawl will engage and hold the small poise. The dials will now indicate the correct weight. Should the small poise run too far back, the rise of the steelyard to the upper jaw will again close the motor and clutch circuits, and the small poise will again travel outward to obtain equilibrium.

The poises therefore cannot come to rest until they have obtained such a position on the steelyard that the latter remains in perfect equilibrium between the two jaws of the end carrier, in other words, the machine itself insists on a perfectly true balance, and is practically incapable of indicating an incorrect weight.

On removing the goods from the platform the steelyard drops on to the lower contact of carrier and the small poise pawl is lifted (as mentioned above) allowing the small poise to run backwards on the rail until it strikes its own rear switch. The latter being pressed back by poise cuts out the small poise magnet from the circuit and includes instead of it the large poise pawl magnet. The large poise pawl is thereupon lifted, and the large poise travels back until it strikes against its own rear switch lever, the latter being pressed back breaks the circuit completely. The two poises are now at zero, both batteries are on open circuit, and the machine is ready for a fresh load. The operation of weighing is performed by the machine in a small fraction of the time it takes to describe it. A perfect equilibrium is obtained in from 6 to 12 seconds after loading the platform, while 2 or 3 seconds suffice for the return of the poises to zero on removing the load. It will thus be apparent that the entire action of the machine is perfectly automatic.

The essential point in the construction of the machine is that with any load on the platform the poise or poises will not come to rest until they have obtained the exact positions on the steelyard that enable them to balance the load. The machine thus automatically insists on a perfect equilibrium, before its revolving dials will stop permanently at any group of figures. In the designing of a machine of this description it will be evident that a large number of points have to be considered.

In the Snelgrove weighing machine the whole of the electro-magnetic mechanism is attached to the steelyard itself, which is then as free to vibrate or oscillate as one of the usual pattern. This is a very important matter from a weighing engineer's point of view. Moreover, the mechanism must be so designed that no revolving or reciprocating parts can, when in motion, cause fluctuations in the centre of gravity or balance of the steelyard.

A multiple arrangement of poises (without which fine indications would be impossible on a steelyard of any reasonable length) requires that the large poise shall only come to rest exactly at pre-determined points, and as a variation in the resting point of $\frac{1}{16}$th of an inch might make an error on the platform of half a hundredweight, it is practically impossible with any system of direct gearing to carry the poise out and stop it with such exactness.

In the Snelgrove machine, however, the most absolute accuracy is attained by ensuring the slight overrunning of the poises, and the return of them and fixture at the pre-determined points by the elastic power of the helical return springs. One more point may be noted, and that is the brake on the free end of steelyard.

This, at first sight, would appear to impair the sensitiveness of the balance, but it is not so. It was found that frequently, when actually balanced by the poises, the momentum of the falling steelyard would carry it to the lower jaw, and consequently close the return circuit, resulting in waste of time. The brake shown is so arranged that it is held by its electro-magnet, which is in circuit with both jaws of carrier quite clear of the steelyard end, at the moment of the latter attaining equilibrium; but applies itself immediately the steelyard breaks contact with either jaw, and checks the momentum and limits the oscillation.

The electric current required to operate the machine is supplied by a small constant battery, concealed in the base, for the usual intermittent work on an ordinary weighbridge. Leclanché cells have been found very satisfactory.

The electric connections and current switches require no attention or manipulation whatever, as they are automatically controlled by the machine itself, on placing the goods to be weighed upon the platform, the machine itself closes the electric circuit, and thus obtains the current necessary to operate its mechanism. The attendant, therefore, beyond placing the goods on the platform, does not touch the machine.

The entire cycle of operations, switching on the current, balancing the machine, indicating the discovered weight in a single group of figures, returning the mechanism to zero when the goods are removed, and finally switching off the current when the weighing is finished to prevent waste being completely performed by the machine itself.

Messrs. Buller, Jobson & Co.—This firm has erected a group of wrought iron tubular standards with wrought iron channel iron arms, for carrying insulators on roofs of houses; these are supported on two imitation roofs, and are fitted with upwards of 400 of their white and brown porcelain terminal and intermediate insulators of the most approved patterns.

In addition to the above they show a wooden telegraph pole with cross arms fitted with Cordeaux's patent screwed double shed white porcelain insulators, as supplied to the Postmaster-General for many years, and for the mannfacture of which they are the sole licensees. They also show telegraph poles entirely of iron (as supplied for abroad), fitted with various kinds of brackets, clips, and insulators, and a Johnson's patent driving pole for rapid erection of telegraph lines, and a large assortment of special pattern insulators and ironwork for telegraphic and telephonic line work.

Galloways, Limited.—This firm, in addition to the two boilers to be seen in action in the machinery annexe, show another at Stand No. 6, with fittings complete, as generally sent out. This boiler is 26 feet long by 6 feet 6 inches diameter, contains 27 Galloway tubes, and is capable of evaporating 5,000 lbs. of water per hour; and with an ordinary compound condensing engine, requiring 20 lbs. of water per H.P. per hour, will drive 250 indicated horse. At Messrs. Galloways, which are the largest boiler works in the world, there are generally 50 or 60 of these boilers either complete or in process of completion, the production averaging over one per day.

Thonet Brothers.—A novel electrolier is to be seen at this exhibit formed of bent wood, after the style of the rocking chairs and other furniture made of bent wood in Austria, and largely used in this country.

Mr. Julius Sax.—A good miscellaneous exhibit has been arranged by Mr. Sax, comprising bells to suit a variety of requirements, burglar and fire alarms, electric clocks, time bells, water gauges, billiard markers, carriage communicators, gas lighters and lightning conductors. The display is one of the most varied and interesting in the building.

Messrs. Appleton, Burbey and Williamson.—At this stand is a good collection of samples of the special classes of fittings manufactured by the firm. The main and distributing switchboards are fitted throughout with their patent adjustable contact switches, and are designed so that all the circuits throughout a large building can be easily controlled and tested. Their main switches, with patent adjustable contacts, being designed for large currents, have ample contact surface in each size, and are substantially constructed. China switches, lamp holders, fuses and ceiling roses are shown in great variety, the ornamentation of some of them being strikingly pretty. Amongst other patterns of fuses is a new single-pole fuse, specially constructed to prevent leakage from the fixing screws. Any of these china fittings can be supplied with patent metal covers spun over the china ones, so that while all the advantages of a china cover are secured, the metal gives a more artistic appearance, and can be made to correspond with any fittings. Some beautiful speci-

mens of decorated china shades for pendant fittings are also shown here, and the wrought iron brackets and other fittings show good workmanship. Linings for battery boxes are made by this firm of a material perfectly acid-proof, and a good insulator which can be worked up into linings of any form and size, the joints being made with a solvent which dissolves the surfaces of the two pieces, which under pressure unite, and form a solid joint. Being extremely light, these cases form in combination with an outer cell of wood or thin metal, a useful and durable battery box for portable shiplighting, launch, tramway, and other purposes, where weight is an important consideration.

REVIEWS.

Useful Rules and Tables. By W. J. M. RANKINE. *With Electrical Engineering Tables and Formulæ*, by A. JAMIESON. Seventh edition. Thoroughly revised by W. J. MILLAR. London: Charles Griffin & Co.

The electrical portion of this book, although it has undergone revision, has hardly been brought to as practically useful a shape as might be desired. Although no doubt it is exceedingly difficult to determine what is and what is not really useful matter, sufficient discretion has, we think, hardly been used in the present case. There is, we consider, far too much mechanical data referring to submarine cables, and pages 416 to 430 savour too much of Prof. Jamieson and too little of generalities; as we pointed out in the pages of the REVIEW when the paper, of which the pages referred to are a reprint, appeared, there were blunders in the same. The whole of the electrical matter, though it undoubtedly adds to the utility of the book, does not impress one with the idea that any particular care has been exercised in selecting material; at the same time, there is much that is commendable in it.

Incandescent Wiring Handbook, with 35 illustrations and five tables. By F. B. BADT, late First Lieutenant Royal Prussian Artillery. First edition. Electrician Publishing Company, Chicago, Ill., 1889.

Mr. Badt, being encouraged by the ready sale met with by his former manuals, "The Dynamo Tenders' Handbook" and "Bellhangers' Handbook," was induced to turn his attention to the subject of incandescent wiring, and the result of his labours has culminated in the production of the practical little treatise under notice.

The object he kept in view was to prepare a handbook comprising practical rules for determining the proper sizes of wires to be used in installations, so that a given current can be carried, without danger and with a given loss of potential, to any required distance; to give instructions and hints concerning the various methods of running the wires, with the best manner of doing so; and to phrase his whole work that it should be comprehensible by the ordinary mechanic.

The book opens with an introductory explanation of the several methods of wiring for electric lighting; of these only two are considered reliable for incandescent work within buildings—viz., the "multiple arc system" and "the three-wire system," the advantages of which are set forth in separate chapters.

Concise instructions will be found for cleat, moulding, and concealed work. As all wiring, for the sake of neatness, should be of the latter class, it cannot be too strongly urged upon architects to make provision, in all new erections, for the future running of electric wires; and the author throws out several suggestions as to the manner in which accommodation can be afforded for the subsequent laying of these wires. The description of a little device, which is called a "fishing hook," for facilitating the laying of wires under a floor, incidentally reveals the fact that carpenters in America are equally partial to concealed work as their brethren in England, and consider that the spaces between the floor joists are intended for the disposal and concealment of all the rubbish that accumulates during their work.

The next portion of the handbook treats of the location of safety devices and switches, and is accompanied by diagrams showing complete details of model circuits on the "Tree" and also on the "Closet" system; the switches and cut-outs being fully represented in their proper positions.

It is somewhat perplexing, at most times, for a stranger to grasp the meaning of the word "bug" when employed by one of our cousins from the other side of the Atlantic; but the difficulty will be further increased by the application of that ill-savoured name to a species of fusible cut-out for the protection of groups of lights. Joints in wires should always be soldered, and the use of acid is recommended in place of rosin, not that a good joint made with rosin is inferior to the acid joint, but the joints as commonly made with rosin are so poor, that it is preferable to run the risk of a joint occasionally failing through the action of the acid. Some day there is a hope that workmen may be obtained who will be able to solder securely with a rosin flux; but pending this, why is not Venice turpentine tried?

In addition to a set of safety rules for fixing electric wires, a chapter is devoted to insulation and testing for faults, in which an illustration is given of a lineman's detector, with one dry cell, capable of detecting any fault under a resistance of 15,000 ohms.

Some useful wrinkles are to be found in a chapter on the wiring of elevators.

Preceded by a few electrical data, we come to the important section of the book, on the calculation of the proper sizes of wires. Starting upon the basis that one foot of pure copper wire 1 circular mil. in cross-section, at the temperature of 75° Fah., has a resistance of 10·79 ohms, the author gradually and simply works up his subject step by step; every step is clearly explained by a set of rules, which are further exemplified by suppositive examples fully figured out. The wiring formula being finally written:—

$$d^2 = \text{N} \times \text{D} \times \text{K};$$

or the size of wire in circular mils. = number of lamps × length of wire in feet × constant.

The constant K is found from the formula:

$$\text{K} = \frac{21{\cdot}58}{\text{r hot lamp}} \times \frac{100 - \text{per cent. of loss of potential.}}{\text{per cent of loss of potential.}}$$

For the convenience of those persons who do not like calculating their own quantities, three charts or tables are appended to the handbook. These tables are constructed for use with lamps of 55, 75 and 110 volts, taking respectively 1·0, ·7338 and ·5 of an ampère for a light of 16 candles, and the proper size of wire for a given loss of potential can be seen at a glance.

The results obtained from the tables and the above formula are not, of course, strictly accurate, as no account has been reckoned of temperature effects; the latter have not been overlooked, however, and another table, No. 1, has been calculated to meet this, on the assumption that a rise of 30° Fah. above the normal temperature gives a safe carrying capacity for any wire. The table includes wires varying in diameter from 50 mils. to 460 mils., and the safe ampère capacity, as well as the number of lamps of the afore-mentioned voltages. The size of wire as found by the loss of potential tables must be compared with No. 1, to ascertain whether it is a safe size to use.

There are numerous persons connected with electric lighting to whom this little manual should be of undoubted service. A copy of it should be in the hands of all workmen employed in internal wiring, and of all those who intend to follow that branch of the profession. The knowledge to be gained from its study should render many a man a valuable assistant, where at present he is only a troublesome and perhaps ignorant labourer.

In the next edition, and it will not be long before it is issued, we might suggest as an addition, which would greatly enhance the value of the book as a comprehensive treatise, a chapter on the effect of various insulating materials in modifying the rise of temperature in wires carrying heavy currents. We feel, however, that the book as it is will meet a real want.

NOTES.

Electric Lighting at Poole and Bournemouth.—At last week's meeting of the Poole Town Council, letters were stated to have been received from the Anglo-American Brush Electric Light Corporation, Limited, and the Electric Construction and Maintenance Company, seeking the consent of the council to applications for provisional orders made to the Board of Trade, in pursuance of the Electric Lighting Acts, 1882 and 1888, authorising the supply of electricity within certain portions of the borough. On the proposition of Mr. Styring, seconded by Mr. K. Aldridge, the necessary consent was given. Three similar applications also came before the Bournemouth Improvement Commissioners, when a committee of the whole Board recommended that the Lighting Committee should be requested to collect information and report to the Board on the matter. This recommendation was approved.

Bradford Electric Lighting.—The Bradford electric lighting works are now almost completed, and it is expected that the system will be formally inaugurated in a week or two. The Chairman of the Electric Lighting Committee is endeavouring to secure the presence of Sir William Thomson at the opening ceremony. Connections have been made with a large number of shops, &c., along the routes of the mains. May the installation prove an entire success.

Hotel Lighting.—The new Midland Railway Station and hotel at Bradford will be opened about the end of September. The hotel, which will rank next in importance to St. Pancras on the Midland Railway system, is being lighted by the electric light. The installation is being carried out by the company's telegraph engineer, Mr. Langdon.

City Electric Lighting—Another Delay.—Once again, says the *City Press*, have the Commissioners of Sewers postponed the question of electric lighting. Tenders were received so long ago as May 10th last, and after long and tedious negotiations extending over three months, terms with three great companies had been agreed, and all seemed to promise well. But the party for delay—some of whom oppose electric light in any form, and some of whom are not interested in the companies selected—managed first to divide the Court equally, and at length to adjourn the debate, after a confession by the solicitor that he did not know anything of the terms arranged. Whatever motive may have induced this adjournment, its occurrence is most regrettable, and may lead to serious consequences. The ratepayers and the public are ill-served by such discussions as took place at the last meeting, which may lead to a reconsideration of the whole position. If the Commissioners of Sewers, who assert certain powers, do not exercise those powers, it must not be forgotten that at our door is another body which claims to be the local authority for the whole metropolis, and is perfectly ready to enforce that assumption by enthusiastic efforts.

The Electric Light for Cowpen Township.—Messrs. Nicholson and Jennings, of Newcastle and London, commenced an agreement with the Cowpen Local Board yesterday to light the township with 18 lamps of 2,000 candle-power each for £525 per annum. This change has been brought about by the Board failing to come to terms with the Blyth Gas Company. Blyth still adheres to the old gas system.

The Electric Light in Paris.—At last Friday's sitting of the Paris Municipal Council it was stated that the electric lighting now being tried on the Boulevards was only partially satisfactory. From the long discussion which took place before the Council, says a Parisian contemporary, it appears that the concessionary companies have done next to nothing.

Paddington Lighting.—At the meeting of the Paddington Vestry on the 6th inst. Mr. Mark Judge moved: "That inasmuch as the Electric Lighting Committee when authorised on November 6th, 1888, to engage the services of Prof. Forbes, F.R.S., at the cost of one hundred guineas, was instructed to report to the Vestry not later than March 30th, 1889, and has now, without presenting any report, adjourned its sittings until after the recess, the said committee be requested to submit their report to the Vestry at the ordinary meeting on September 17th; further, that in the event of no report being then forthcoming, the reference to the committee be discharged, and that the Vestry do then and there proceed to consider what steps should be taken to prepare for the issue of the necessary advertisements, which, to be in time for the Session of 1890, must be published on three successive weeks in October or November of this year, and be deposited with maps on or before November 30th, 1889." It was argued that such delay was dangerous, as there were several companies angling in Paddington, and might take upon themselves to go to Parliament and obtain the powers the Vestry should have. Upon the Vestry Clerk stating that a very valuable report on the whole subject was being framed, it was decided to let the matter stand over for the recess. The Vestry then adjourned until September 17th.

The Acheson Effect.—The New York *Electrical Review* states that Mr. Acheson has just taken out three patents for the conversion of heat into electricity. Some time ago a fantastic scheme, evolved from the teeming brain of this gentleman, was commented upon in our columns; but now our contemporary thinks that he is on the way to achieving something substantial by the employment of the following extraordinary arrangement:—"By means of an alternating current generator in a circuit in which he prefers to enclose an iron core of the ring type, he produces magnetic waves, and these by induction impress an E.M.F. in a secondary circuit wound upon the same core, the apparatus thus far practically constituting a transformer. He then applies flame or other source of heat to the *iron core* at a point devoid of winding, and by some process, not clearly set forth in the patents, an additional E.M.F. is impressed upon the secondary circuit. This additional E.M.F., in the practical experiments which the writer had the pleasure of witnessing, can and does exceed the E.M.F. impressed by the primary alternating current; so that in reality the electric energy due to the inductive transformation can be doubled by the action of his new thermic transformer. The announced results are too remarkable not to attract widespread attention and experimenting everywhere. The practical bearing of the invention will be grasped by our readers when we say that, if the *Acheson effect* (if we may so christen it) is a reality, its application to existing plants of the alternating type would at once double their capacity without requiring any additional engine-power. This is a thing worth investigation." Why does not the New York *Electrical Review* set to work and investigate it? What a severe lesson it would be to electricians, both here and in the States, if our contemporary would only show that all the efforts which have hitherto been made to prevent the heating of cores were based upon wrong premises.

Fowler-Waring Cables Company.—The subscription list for shares in this company will close this day, Friday.

Glasgow District Telephone Directory.—We have been favoured with a presentation copy of the new edition of this directory, published by the National Telephone Company for the use of their subscribers in the Glasgow district. The list of names shows a very satisfactory increase, both in the number and in the wide range of businesses represented. The book is excellently compiled and printed, and contains information of much value to those who are connected with the many exchanges on the system.

Books Received.—The sixth volume of the Proceedings of the Ninth Convention Annual Meeting of the American National Electric Light Association, 1889, has reached us. It contains the report of the committee on underground conduits and conductors; Mr. Barton's paper on "Electric Light Stations as Fire Risks;" "Disruptive Discharges in Lead Cables," by C. H. Rudd; "Fuel Oil," by S. S. Leonard; "Liquid Fuel," by M. J. Francisco; "Advantages of Oil as a Fuel," by C. M. Ransom; "Conduits: Their Material in Relation to Insulated Conductors," by A. C. Chenoweth; and "Municipal Lighting," by Fred. H. Whipple. Most of these papers are familiar to our readers, either in full or abstract. The "Journal of the Institution of Electrical Engineers," No. 81, Vol. XVIII., contains the discussion on Dr. Lodge's paper, "Lightning, Lightning Conductors, and Lightning Protectors," Mr. Mordey's paper and discussion on "Alternate Current Working," and Sir William Thomson's paper "On the Security against Disturbance of Ships' Compasses by Electric Lighting Appliances."

Annual Excursions.—On Saturday, the 3rd inst., the *employés* of the General Electric Company, Limited, (trading until recently as the Manchester Electric Works Company) had their annual picnic at Rudyard Lake. Dinner was partaken at the hotel, Rudyard, after which the manager, Mr. Max Binswanger, proposed the health of "Men and Staff." Seeing that the company had been in existence for a brief period only, he congratulated them upon the success achieved, and the rapid strides in the development thereof; the *employés* number only at present 200. Having spoken of the recent amalgamation with the General Electric Company, Limited, London (Messrs. G. Binswanger & Co.), he reminded his hearers of the wide scope and prominent bearing of electricity to modern and future requirements, stimulating them to activity, perservance, and study. Messrs. Coates, Butterworth, and M. Hirst proposed the health of the London house and that of the directors, Messrs. G. Binswanger and H. Hirst, including the names of subscribers and friends. A hearty vote of thanks having been tendered to Mr. Max Binswanger for presiding, the party dispersed until tea. Although showery, it was a most enjoyable trip, and all were satisfied with the day's outing.

Celluvert.—We recently called attention to this material, which is being introduced to the electrical trade in this country by Messrs. Moseley and Sons, of Manchester. We are glad to hear that it is being found useful in connection with dynamo building, and in the manufacture of electrical sundries, such as fuse mounts for cut-outs. Its great strength fits it for certain uses where ebonite, in this respect, is inferior, its insulating power when dry being equally high. Its use, however, is not to be recommended where freedom from moisture cannot be relied upon.

Electric Bells.—Estimates are required for making perfect and maintaining in thorough repair for a year the whole of the electric bells and wires, and the apparatus connected therewith, fixed in the fifty-nine land and river stations of the London Fire Brigade and in houses used as lodgings for firemen, for the London County Council. Particulars may be obtained on application at the Architect's Department of the Council, Spring Gardens, S.W.

Subsidy Refused to the Canadian Cable Company.—It is reported from Ottawa that the British Government has refused to subsidise the new direct Canadian cable. Lord Salisbury states that the idea of granting a subsidy to this new line was to secure direct cable communication between Great Britain and the Dominion, which has been done within the past few weeks by the Anglo-American Company lifting its cable at Newfoundland and splicing it with a new cable into Halifax, by express agreement with the British Government. Subscriptions have, however, been secured in England to the extent of £70,000.

American Engines.—The Ball Engine Company, of Erie, Pa., manufacturers of the Ball High-speed Automatic Cut-off Engine, is making considerable additions to both machinery and buildings. It will give an idea of the demand for this engine when we mention the fact that the company have orders for 7,165 horse-power of engines to build for electric companies. The company has just completed the first of the 12 300-horse-power compound engines for the Edison Electric Illuminating Company, of Brooklyn, and the tests made at the factory were very satisfactory. The first two engines for this large plant will be shipped in a few days, and when placed on their foundations an exhaustive test will be made.

Gent and Company, Leicester.—This firm issues an excellent book of practical instructions as to the fixing and repairing of electric and pneumatic bells, telephones, &c., containing descriptions and prices of all the necessary accessories. Particulars are also given of electric light and power apparatus, electric fittings, and electro-medical appliances. It is well printed and profusely illustrated, and we are not aware of any price list in the trade forming so complete a guide for the bellhanger, gasfitter, plumber, and amateur. The seventh edition is just published, containing several novelties, one of which is an electric bell of "church bell" shape, having a nickel-plated bottom, which excludes dust while not affecting the sound.

Supply of Electricity in Sheffield.—The Improvement Committee have had under consideration notices from the solicitor and the secretary of the Electric Construction and Maintenance Company, Limited, of their intention to apply next session to the Board of Trade for a provisional order to supply electricity within the borough. The committee recommend the Council "to intimate to the solicitor and secretary of the company that they will not give their consent to any provisional order being granted to the company for supplying electricity in Sheffield, on the ground that the Council may probably themselves seek to obtain powers necessary for that purpose."

Electricity versus Wrinkles.—The news comes from Paris that an institution has been established for the removal of wrinkles by electricity. This, if true, will doubtless be good news to the *fair* sex, and henceforth arsenic will not be necessary as a cosmetic. There will be a gigantic procession of ladies from the West End, and probably the new reviver will hold as high a position as did Ninon de Lenelos asses milk.

The St. Louis Universal Electrical Exposition.—This exposition is progressing rapidly under the general management of Mr. Fred. H. Whipple. An immense phonograph will be used to reproduce the music played by the Liberati and Gilmore military bands. An electric street railway complete will be in operation the full length of the great building. A cooking establishment, also operated by electricity, will claim the attention of the visitors. Pianos, organs, and musical instruments of all kinds will be operated by the current, and a drum corps of astonishing effect will likewise have wire connections.

Electric Communication.—Among the Parliamentary notices of motion for which no days have been fixed is the following, in the name of Sir George Baden-Powell:—"To call attention to the existing deficiencies in electric communication along the coasts of the United Kingdom, and to move: That, with a view to the better prevention of loss of life and property in cases of shipwreck, for the general advantage of the shipping and fishing industries, and for the more effectual defence of these realms in time of war, it is necessary to provide electric communication between the postal telegraph system and all coastguard, lighthouse, lifeboat, and life-saving stations situated on the coasts of the United Kingdom."

"Come One, Come All!"—No less than five electric lighting companies have given statutory notices of their intention to apply to the Board of Trade for electric lighting orders, authorising them to supply electric light in the borough of Derby. This has driven the Corporation to decide to keep the matter in their own hands, by applying to the Board of Trade for an order to make and supply electric light themselves. It is contemplated to make a trial of the scheme in the town centre, before extending it throughout the borough.

Which is the Best Tramcar Starter?—The London Street Tramways Company has fixed an apparatus to facilitate the starting of the cars, thereby lessening the strain put upon the horses; if they are desirous to still further minimise the strain, we should recommend an electro-motor, which would free the horses for evermore.

Submarine Torpedo Boats.—A short time since we gave some particulars in a Note of an eight hours' submersion of a torpedo boat. A French contemporary, referring to the same vessel, gives us some further details, as follows:—"It is not of to-day that search is made, a little in every country, for the solution of a problem which seems now as impossible to solve as that of the steering of balloons; it is of the submarine boat that I wish to speak. M. Goubet has just concluded a long series of experiments with a submarine boat of his invention. This boat has been spoken of for a long time. The numerous preceding abortive attempts had put people on their guard against submarine vessels. Successful attempts were valueless against this state of mind until it became necessary to recognise the fact that a solution of the problem had been found when the *Goubet*, that is the name of the vessel, had remained eight hours submerged with two men on board, who smoked, ate, and played at cards without the slightest inconvenience. How is this vessel constructed which so well merits its name of fish-boat? This secret, like others relating to national defence, is well kept. But whatever the mechanism and the system which works the *Goubet*, the experiments which are being continued at Cherbourg prove that it is efficacious. The naval authorities have not such a tender feeling for inventors in general that it would have consented, if the invention had not appeared really practical and capable of rendering real service, to place at M. Goubet's disposal a basin at the port of Cherbourg, and also officers and sailors. The new boat was able, during the course of the experiments, to sink at command to variable depths and to maintain a perfect equilibrium. The sinking of the *Goubet* was brought about with the greatest regularity, without oscillation or shock, quickly or slowly, according to the orders transmitted through the telephone wire which communicated between the submarine boat and the pontoon. At the different depths the *Goubet* was manœuvred at will, and behaved as much like a fish as possible."

Telephone Extension at Portsmouth.—At the last monthly meeting of the Portsmouth County Council the Roads and Works Committee reported: "Your committee submit an agreement with the Western Counties and South Wales Telephone Company in reference to the erection of poles, to carry wires for placing this town in telephonic communication with Winchester, Bournemouth, and other towns. This agreement provides for the poles to be erected in streets being considered as on suffrance only, and as your committee think the proposed communication will be beneficial to the town they recommend that the common seal be affixed to the agreement." Sir William King, in moving the adoption of the clause, pointed out that this would only necessitate the laying of one wire. Mr. Dittman suggested that the wires should be carried underground. The Mayor: You cannot lay telephone wires underground; it has never been done. After some further discussion the clause was agreed to.

Mr. Gibbens on Shocks.—Mr. Gibbens, of the New York Board of Electrical Control, the same gentleman to whom we referred in our leaderettes of the 2nd inst., is evidently a leader in science. He doubts if an electric current can be produced which will infallibly cause instantaneous death. He says: "I base my doubt upon the very different effects of electricity upon different organisms. Death by electricity, whenever it occurs, must, in my opinion, be caused by shock. If the shock is not sufficient to produce death, and the blood is merely polarised, the subject, though seemingly dead, is very likely to be kept alive and finally resuscitated by the depolarising effect of the opposite electricity with which the human system is stored." Bravo Mr. Gibbens! According to your theory every man has stored within him the electrical elements for his own destruction. The evidence on electrical execution will make pretty history in course of time.

Electric Lighting in Plymouth.—Much success has attended the visit to Plymouth of Mr. Bingham, engineer of the Devon and Cornwall Electricity Supply Company. Upwards of 3,000 incandescent lights have been definitely ordered for various shops, private establishments, and public places, which more than warrants the company in going forward with their operations. The plant to be laid down in the first instance will be only sufficient to supply 4,000 incandescent lights and 100 arcs, and when this has been ordered no further engagements will be entered into until additional plant is introduced. The canvass which has been made in Plymouth, Devonport, and Stonehouse has been remarkably successful; and before winter sets in the electric light will have become pretty general in the principal establishments of Plymouth.

Electrical Resistance of the Human Body.—In Mr. Kennelly's article on the above subject in our present issue, it is stated that with the hands immersed in a caustic potash solution, the resistance between the hands was 30 per cent. less than was the case when an aqueous solution of zinc sulphate was used; this is a conclusive proof that the bulk of the resistance is skin deep only, as the potash, of course, could not effect the reduction by penetrating into the mass of the body which formed the circuit. The alkaline solution evidently eliminates the surface resistance offered by the oily nature of the skin.

Telephonic Extension in Hampshire.—At the quarterly meeting of the Hampshire County Council held at Winchester on Monday, under the presidency of Lord Basing, a report was brought up by the Main Road and Bridges Committee, showing that application had been made by the Western Counties and South Wales Telephone Company for permission to erect telephone poles and wires by the side of certain main roads in the county, as duly shown in plans. The committee recommended that the Council should give them authority to deal generally with the subject, so as to enable them from time to time to give the necessary permissions upon such terms as they might consider expedient. The recommendation was adopted.

A Railway Station Struck by Lightning.—On Monday afternoon, about five o'clock, during a severe and heavy thunderstorm, which passed over Stalham, the Eastern and Midlands Railway Station was struck by lightning and considerable damage done. It passed down the office chimney and struck the telegraph instrument, breaking all the wires, passing off on to the shelf and setting fire to it; it ultimately broke through the window and escaped. Fortunately no one was on the station at the time, the clerk having just left his office, but this alarming circumstance having been seen by some passers by, the news quickly spread among the inhabitants, while assistance was soon procured to extinguish the flames, which was done in about twenty minutes, and before they had got a very firm hold of the building.

Formula for Wiring.—Mr. G. T. Evans, in the *Electrical World* of New York, gives this formula for calculating the size of wire to be used for electric lighting with any drop of potential required :—

$$\frac{10{\cdot}3 \times l \times n \times v}{R \times D} = \text{area in circular mils.}$$

where 10·3 = area in circular mils. of 1 foot of copper wire having a resistance of 1 ohm ;

l = total length of wire in feet,

n = number of lamps,

v = voltage of lamps,

R = average resistance of lamp,

D = drop in volts in wire.

As an example. A line 200 feet long to supply 50 lamps at 100 volts pressure with a fall of potential of 2 volts, resistance of lamp about 180 ohms,

then,
$$\frac{10{\cdot}3 \times 200 \times 50 \times 100}{180 \times 2}$$
$$= \frac{10{,}300{,}000}{360}$$
= 28,611 circular mils.
= 169 mils. diameter,

which has an area of ·0225 of a square inch, and will carry at the Board of Trade capacity of 1,000 ampères per square inch, 22·5 ampères. But the wire in the above example has to take about 25 per cent. more current than is permissible here, therefore we would recommend the users of Mr. Evans's formula to substitute *square mils.* instead of circular mils. ; in that case the carrying capacity will be well within the Board of Trade limit. Of course, when a heavy current has to be used, the temperature coefficient must not be neglected, so as to conform with the requirements of the insurance companies.

A Present for John W. Mackay.—The *New York Times* of July 24th says :—John W. Mackay spent Monday evening with a score of his Commercial Cable *employés*.. They descended upon him unexpectedly at the Windsor Hotel, bearing a unique album as a gift to him. In the album were pen drawing of characteristic scenes in every city where his cable company has an office. There was a little speech-making and a good deal of cork popping, and Mr. Mackay's countenance couldn't have been one whit happier had his guests been millionaires and the gift a Prince's ransom.

The Prince of Wales and Electric Launches.—The Prince of Wales a few days ago ordered Messrs. Immisch & Co.'s electric launch, the *Viscountess Bury*, for the use of himself and a distinguished party. Starting from Kew Bridge for Sunbury, a visit was paid to Platt's Eyot, where the above-mentioned firm has a charging station. An electric torpedo boat in course of completion attracted some attention, and after a trip in several of the smaller launches the party proceeded down the river, landing at Chelsea. The electric launch scheme, which at Henley Regatta last year was but in embryo, has made great progress, and a considerable number of these graceful craft now enliven the river.

Oldham.—We notice that at the works of Messrs. S. Charlesworth and Co., Electrical Engineers, Richmond Hill, Oldham, there is increased activity, the firm being busy over a large number of various sized dynamos (Hall's patent) for home and foreign order. The demand for this dynamo (one form of which we recently illustrated as portion of a Suez Canal lighting plant) is gradually extending. Messrs. Charlesworth and Co. are also busy in general engineering work, and in the manufacture of special engines for electrical lighting. It has been necessary to considerably extend the present works, and as the business has still further increased an additional extension to their shops has been decided upon.

NEW COMPANIES REGISTERED.

Universal Automatic Advertiser Company, Limited.—Capital, £10,000 in £5 shares. Objects : To manufacture automatic advertising machines, and to carry on business as mechanical, electrical, and general engineers. An agreement with the London Battery Company, Limited, will be adopted. Signatories : *R. J. S. Beeton, 29, West Hill, Sydenham, 100 shares ; H. A. Jones, 14, Hendon Street, S.W. ; W. J. Hallett, 7, St. Martin's Place, W.C. ; E. F. Mogg, Wolfston House, Upper Tooting ; J. T. Stainforth, 56, Adys Road, East Dulwich ; Thos. Ivers, 2, Caledonian Street, Grosvenor Road, S.W. ; *H. Upton, Furze Dene, Brighton (electrical engineer), 1 share each. The signatories denoted by an asterisk, and Willoughby Wallace, St. John's, Bishopstoke, are the first directors ; remuneration, £50 per annum each, with an additional £25 for the chairman ; also 10 per cent. of the balance of net profit after payment of 10 per cent. dividend. Qualification, £100 in shares or stock. Registered 10th inst. by H. P. Spottiswoode, 32, Craven Street, Strand. Registered office, Bridge House, 181, Queen Victoria Street.

Brush Electrical Engineering Company, Limited.—Capital, £750,000 divided into 150,000 preference shares of £2 each, and 150,000 ordinary shares of £3 each. Objects : To take over the business of Anglo-American Brush Electric Light Corporation, Limited, in the United Kingdom and elsewhere, with all patents, premises, fixed and movable plant, and other property. To acquire the undertaking and business of the Falcon Engine and Car Works, Limited, at Loughborough, Leicester. To carry on business as electrical, mechanical and general engineers, carriage and car makers. To acquire, manufacture, and put up and sell telegraphs, cables, phonographs, and all electrical apparatus now known, or that may be hereafter invented. The signatories, each of whom subscribe for one ordinary and one preference share, are as follows : *Lord Thurlow, 33, Chesham Place ; *J. S. Sellon, 78, Hatton Garden ; Emile Garcke, 112, Belvedere Road, Lambeth ; *Col. F. G. Steuart, 16, St. James's Square ; Ernest Cooper, 14, George Street, Mansion House ; *E. Woods, C.E., 45, Onslow Gardens ; J. S. Raworth, 112, Belvedere Road, Lambeth. The signatories denoted by an asterisk are the first directors, together with the Duke of Marlborough, J. B. Braithwaite, jun., and Aymor H. Sanderson. Qualification, £500 in shares or stock ; remuneration, a sum not exceeding £2,000 per annum, and in each year in which 10 per cent. dividend is paid on the ordinary shares, an additional sum equal to one-tenth of the amount of such dividend, but such additional amount shall not exceed £10,000 in any year. Registered 10th inst. by Messrs. Renshaws, 2, Suffolk Lane, Cannon Street.

Fowler-Waring Cables Company, Limited.—Capital, £200,000 in £5 shares. Objects : To acquire the businesses and goodwill of John Fowler and Company, (Leeds), Limited, and of Mr. Richard Solomon Waring, of 85, Queen Street, E.C., as manufacturers of and dealers in electric or other cables. To adopt a contract of 12th inst., between R. W. Eddison of the first part, John Fowler and Company (Leeds), Limited, of the second part, and R. S. Waring of the third part. To manufacture and deal in cables, wires, and all materials, machines, and appliances for telegraphs, telephones, or for lighting, motive power, and generally to carry on the business of electrical engineers, or of a telegraph maintenance and construction company. Signatories (with 100 ordinary shares each) : *Wm. Fowler, 43, Grosvenor Square ; *George Fleming, 9, Billiter Square, E.C. ; *The Hon. J. S. Gathorne Hardy, M.P., 2, Cadogan Square ; *Walter Chamberlain, Harborne Hall, Birmingham ; *Col. J. T. North, Eltham, Kent ; *R. W. Eddison, Steam Plough Works, Leeds ; *R. S. Waring, 85, Queen Street, E.C. The signatories are the first directors ; qualification £500 in shares ; remuneration, £2,000 per annum, to be divided as they may determine. Registered 13th inst. by Paine, Son and Pollock, 14, St. Helen's Place.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Halifax and Bermuda Cable Company, Limited.—An agreement of 24th May (filed 28th June) with the International Cable Company, Limited, provides for the transfer to this company of the benefit of contracts of 12th April and 13th May relating to the construction of a submarine cable between Halifax and Bermuda. The purchase consideration is £44,965 in ordinary fully paid shares.

CITY NOTES, REPORTS, MEETINGS, &c.

United River Plate Telephone Company, Limited.

THE 3rd annual meeting of this company was held at Winchester House yesterday week. Lord Thurlow in the chair.

The Secretary having read the notice convening the meeting,

The Chairman said: As customary, I shall proceed to say a very few words. I think all must admit a highly satisfactory balance sheet, with one solitary exception, and that solitary exception, which is the key of the report and to the small dividend which we declare, is undoubtedly the loss on exchange. That is a circumstance which has been absolutely beyond the control of the Board. It has been unprecedently high and of unprecedently long continuance. We hope that in the future it will not occur again to the same extent. At the same time it is so very serious a subject that I think you will pardon me for referring to it. It absolutely absorbs on the present occasion 5 per cent. on the subscribed capital, which shows a loss of £14,000, and which means that instead of recommending, as we are doing, a dividend at the rate of 3 per cent., it would have been in our power to offer you 8 per cent. in addition to the interim already paid. This is a grievous state of things and it behoves the board to do what they can to ensure that this does not occur, at any rate to the same extent, in succeeding years. Throughout the duration of the last year our attention has been drawn to it and we have always been hoping that the loss would be mitigated, instead of which, as you all know, it has been constantly aggravated as time went on. For my own part, I hold very decidedly that it will be necessary for us to take some steps to provide against this recurrence. Of course, there are two ways of meeting it; but neither of them should be adopted without very mature consideration. One is raising the rates for subscribers, and the other adopting the system of partial payments in gold and part in paper currency, because it is obvious if the payment were half in gold and half in currency, the one would act as a counterpoise to the other, so that what you lost on the paper currency would be gained in the gold. However, as I said, the matter, although ripe for consideration, cannot be decided hastily, and I am very glad to be able to say that we shall have the advice and experience of Mr. Fels, who has just returned from the River Plate, and is in this room to-day. He only arrived from Buenos Ayres the day before yesterday, and has not had time yet to give us the benefit of his views on this point; but you may, I think, take it for granted that we shall lose no time in consulting him, and adopting whatever means we may think wise and prudent to lessen this loss for the future. We now give 3 per cent. in addition to the 3 per cent. which has been paid, making at the rate of 6 per cent. per annum. One word by way of comparison with our report issued last year, which, as you know, represented a period of 16 months. For that period we paid 7 per cent. If you examine this carefully you will find that 7 per cent. for 16 months is only 5¼ for the 12 months, so that we are actually offering you ¾ per cent. more than for the corresponding 12 months of last year, so that notwithstanding the adverse exchange, we have actually done better during the last 12 months. I will say a few words on the subject of our general business, which I am glad to say is entirely satisfactory at the present moment. The company commenced with 3,150 subscribers in and immediately about Buenos Ayres; that figure has now been raised by rather more than 50 per cent., which is extremely satisfactory. Another satisfactory feature is the almost cessation of complaints, and the general satisfaction our service is now giving. That is a point to which we attach very great importance. We have had from the commencement a very high standard of perfection as the point to be aimed at, and I think we have arrived at a stage which, if it does not, so far as I am informed, actually come up to the very high standard we had fixed, at the same time is a certainly much higher standard than people are accustomed to in Europe. With regard to the sales business, which, as you may remember in the original prospectus was estimated to bring in a profit of £4,000 a year at the least, that estimate has been more than doubled, and this is likely to continue for several years. The working expenses have been raised to a higher figure than they would have stood at by the occurrence some months ago of a very severe storm or cyclone. These storms, hurricanes, and cyclones may be matters of frequent occurrence, and perhaps constant occurrence in the River Plate; still this one was of such unusual severity as to do very great damage to the system of our wires, and caused an additional expenditure of something like £2,000 to repair it. Notwithstanding that, taking into consideration our increased number of subscribers, our working expenses do not stand at a higher figure than they did for the past 12 months. You will doubtless be anxious to hear something of the Rosario business which we have acquired. Rosario is a most promising commercial place, and is hardly liable or subject to any falling off; those who know Rosario best ensure a most prosperous future. There were two companies then, and we were exposed, as you know, until we purchased this second one to competition and competitive rates. We entered into an agreement for the purchase of this opposition company with the parties who owned it, and I am thankful to say that these negotiations were carried out in a most amicable spirit, and at a very fair and reasonable price. We have now obtained the service of their company, and have installed in the business at Rosario a very competent manager who, I believe, is giving universal satisfaction. The number of subscribers has largely increased to something like 40 per cent. during the past six months. There is every prospect before us of a continuous improvement, so that so far from there being any cause to regret the acquisition of that property we may fairly congratulate the shareholders on that arrangement having being satisfactorily carried out. I believe that the acquisition of that property, and the absolute control that it gives us over the telephone arrangements of that rising town, and the towns surrounding it, and growing up in the line of railway between it and Buenos Ayres—along which, as time goes on, we undoubtedly shall establish a trunk line—I say that the acquisition of this property, and having therefore absorbed the competition in Rosario itself, has done more to consolidate our position and our power and influence over the telephone arrangements in the whole of the Argentine Republic than any other step we could have taken. Owing to various circumstances during the past year we have been able to keep in the closest touch with our business on the other side of the world; this is greatly due in the early part of the year to the presence here of Mr. Krabbe, our consulting director localised at Buenos Ayres. He came over to England for a well-earned holiday during the latter part of last season, and stayed several months; he attended our meetings and gave us the benefit of his ripe experience. He has now returned to Buenos Ayres, and has practically undertaken the supervision during the absence of our competent manager, Mr. Fels. Then, again, two of our directors at different times have this year visited the River Plate—Mr. Coghlan and Mr. Le Rossignol. The former gentleman is not able to be here to-day to report upon his visit, having been ordered abroad for the benefit of his health; but I am glad to say that Mr. Rossignol is here, and after I have done he will address to you a few words and explain shortly the satisfactory condition of affairs which he found when in Buenos Ayres, and which he left only a few weeks ago. Thanks to the circumstances to which I have referred, thanks to the energy that has been displayed in the management by Mr. Fels and by Mr. Krabbe, and to the successful acquisition of Rosario, our position leaves really nothing to be desired, except that prosperity that we enjoy should continue. But, while we have the satisfactory results of the past 12 months to look back upon, I would ask to believe that a business of this kind at the other side of the globe cannot be conducted from London by responsible directors without a considerable amount of ceaseless anxiety, and their responsibility attaching the telephone business will, I think, render the argument that I have ventured to use specially applicable. That anxiety on the present occasion, I am glad to say, has been greatly mitigated by two circumstances, one at home and the other abroad, and which have made the responsibilities rest lightly on our shoulders: one is the knowledge that we have in the office Mr. Unwin, in whom we not only can place the utmost and complete reliance for the due performance of the details of the business, but in whose wisdom and experience of South America you all know we have the very greatest confidence. I have already referred to Mr. Krabbe and Mr. Fels for their assistance in Buenos Ayres. Without the feeling that one can rely absolutely on the gentlemen that assist us in this enterprise, I can assure you that it would be almost impossible to manage a business of this description, and of this magnitude, from so great a distance as London is from Buenos Ayres. I have great pleasure in moving the adoption of the report.

Mr. J. Irving Courtenay seconded the motion.

Mr. Alfred Le Rossignol said he had found everything working satisfactorily; the complaints were extremely few. There was a rapid development, which was proved by the daily increasing list of subscribers. The town of Buenos Ayres during the past four or five years had increased 50 per cent., and was still increasing, the company's prospects could not be brighter. The telephone was used there much more than in England owing to the absence of good roads and faulty postal arrangements. Private individuals living out in the country considered it necessary to make use of the telephone, in fact, it had become a universal necessity. He had not time to visit Rosario, but it was developing faster than Buenos Ayres in a way that was unknown in Europe. It might be called the Chicago of the River Plate. Business in Rosario might still be considered in its infancy, but as he said there would be a rapid development in all respects. The little competition they had he thought was doing more good than otherwise.

Mr. Lloyd addressed the meeting with regard to the acquisition of the Rosario business, and did not think the arrangements were carried out in an amicable manner.

Mr. Lawrence asked some questions as to the accounts.

The Chairman expressed surprise at the action of Mr. Lloyd who, until quite recently, was a member of the board, and had never before spoken so adversely as to the Rosario acquirement.

The motion was then put to the meeting and carried unanimously. Mr. Frank Jones, Mr. George Cooper and Mr. Alfred Le Rossignol were then re-elected.

Mr. Duncan proposed a vote of thanks to the chairman, and congratulated the board on the very able manner in which they had carried out the arrangements with the Rosario Company.

The proceedings then terminated.

City of London and Southwark Subway Company.

In the report presented to the shareholders at the tenth half-yearly ordinary meeting of the company, held at Winchester House on Tuesday, the directors have the pleasure to report that the whole of the tunnels from the City to a point considerably beyond the Kennington Oval Station, a distance of about 2¾ miles, have been completed and the main underground works at the King William Street, Great Dover Street and Stockwell stations have also been finished, and those at the other three stations are in a forward state. The station buildings on the surface at Great Dover Street and the Elephant and Castle have been commenced and the necessary alterations of the buildings at King William Street, to fit them for the City station and for the company's offices are nearly completed. A short piece of tunnelling, about 250 yards in length, between the Oval and the terminus at Stockwell is still incomplete, owing to the existence of a wet bed of gravel through which the work is being carried on under air pressure, a somewhat slow and tedious process.

The boiler house at the Stockwell depôt is approaching completion, and the boilers are being placed in position. The other works at this depôt in connection with the electric supply, the hydraulic power for working the lifts, the carriage sheds and workshops, are also making good progress.

The rails are now laid in the tunnels between King William Street and Great Dover Street Stations, and an experimental train worked by electricity is nearly ready for trial on this section.

During the half year a further sum of £75,000 in ordinary shares has been placed, making the total share capital subscribed £500,000.

The committee of the Stock Exchange have granted a quotation for the company's shares.

At the meeting Mr. Charles Grey Mott occupied the chair. The Secretary having read the notice convening the meeting,

The Chairman, in moving the adoption of the report, said he was glad to say that during the past half-year they had carried out some very extensive works without any serious accidents whatever. The whole of the tunnel forming the subway, with the exception of the small portion between the Oval and the terminus at Stockwell, were complete. The underground work at the three stations, King William Street, Great Dover Street, and Stockwell stations were also finished, and the work at the other stations was proceeding very rapidly, and in about eight weeks they hoped that the whole of the stations would be complete. They had also commenced the erection of two surface stations at Great Dover Street and the Elephant and Castle. As the shareholders were aware, the buildings at King William Street were already erected and the lower part was being altered into the permanent station and the upper part fitted out for offices for the company. The work in the wet ground was delaying the opening of the line. There was practically no difficulty beyond the question of time. Were it not for this delay, they might congratulate themselves upon everything being perfectly right. But, as expressed in the report, it was a slow process—one which had hardly ever been used in a similar way—and there was therefore no experience to guide them in that respect. They had recently decided to take measures by which the progress would be considerably expedited. They had to provide a vast amount of machinery for the working of the line and had purchased a large piece of land at the Stockwell end for placing that machinery. Great progress had been made on the works there, and a very large boiler house below the level of the surface had been constructed and three boilers were now in position. They had also in progress an engine house, a house to contain the dynamos and all the hydraulic engines and works connected with the hydraulic supply for working the lifts, also sheds for carriages and engines, and workshops for the general purposes of the line. For these extensive works considerable time was required, but they would all be ready long before they were required. The permanent rails were laid almost the entire length in one tunnel, and partly in another. The carriages and engines for the experimental train were already in the tunnel, and the contractors' preliminary trial would doubtless take place before many days were over. The station at King William Street would shortly receive the tile lining, and would then be as complete as they could make it. During the last half-year they had raised in additional capital the sum of £75,000, and they considered that would be sufficient for the purposes of the line until it was opened. They had raised it not by advertisements, but by arrangements with financial houses in the City, and had thereby saved the expenses of advertising, although some concession had to be made in the question of commission and price. When he (the chairman) last stood before them, he expressed the hope that he should be able at the next meeting to tell them what day the line would be opened for traffic. No one could be more disappointed than he and the directors that there should be any further delay, but when the shareholders considered that the construction of the whole subway was perfectly novel, and the working power and the arrangements, in many cases were entirely new, they would understand how much thought and consideration had to be given to every detail, in order that there might be no failure when they came to the opening of the line. In almost all railway works contractors very seldom completed the works in the specified time, and in such unusual works as these the shareholders must have a little more patience than in ordinary kind of works. Everything had been done to carry out the work with absolute carefulness, and with as much expedition as the nature of the undertaking would allow. The chairman then formally moved the adoption of the report, which was seconded by Mr. Hubbard. A few questions were asked by shareholders, which were satisfactorily disposed of by the chairman.

A vote of thanks to the chairman and the directors brought the meeting to a close.

Anglo-American Brush Electric Light Corporation, Limited.

The adjourned meeting was held at the offices of the Company, Belvedere Road, on Wednesday. Mr. J. B. Sellon occupied the chair.

The Chairman said: This is, as you are aware, an adjourned meeting to supplement that held last Wednesday. It was called in anticipation of the new company being registered by that date, but as it was found impossible to complete all the formalities in time, it was necessary to adjourn until to-day in order to confirm the three resolutions which were passed unanimously at the meeting held at the Cannon Street Hotel on the 26th July. The resolutions were explained on that occasion very fully by the chairman, Lord Thurlow, who I regret is unable to attend to-day, and after discussion, met with general approval, and you will, I hope, feel assured that they would not have been put forward by your directors had they not, after mature consideration, arrived at the conclusion that they would be advantageous to your individual interests as well as the general welfare of the corporation. The new title, The Brush Electrical Engineering Company, was registered on the 10th inst., and will take over the business of the corporation as from the 1st of August, which was arranged in the agreement. The Falcon Company will hold their confirmatory meeting to-morrow, after which the agreement of that company will be exchanged and completed. With regard to the proposed agreement with the Australasian Company, it will be remembered that the chairman explained at the meeting on the 26th July that some difficulties had presented themselves which it was hoped would easily be removed. Those troubles have been found to be greater than was anticipated, and although the negotiations have been continued in the interval, the only basis which in view of adequately protecting your interests we have thought it right to demand, has not yet been agreed to. Negotiations are, however, being continued in an amicable spirit, and we hope that an understanding satisfactory to both companies will be arrived at. The majority of the debenture holders have already given their assent to the scheme of reconstruction, and everything else that is necessary to carry into effect that scheme is in a satisfactory condition.

Mr. Lane-Fox: I think it only right to mention that I have certain unsettled claims against the Brush Company. The liquidation of the company makes it imperative that these differences should now be dealt with, and I am afraid that unless we can come to an immediate understanding the whole question of my early connection with the Brush Company, down to the present, will have to be reconsidered. I have done everything that was possible to get them settled amicably; hitherto, however, I have allowed myself to be put off with vague assurances. I should add that quite recently a very equitable proposal has been submitted to them on lines which I understood from the manager they were willing to agree to, but as I have not received from them any satisfactory assurance of a settlement, I am compelled to refer to the matter at this meeting.

The Chairman: Any claims whatever that Mr. Lane-Fox has against the corporation will in due course come before the liquidation and be properly considered. With regard to the special proposition which he refers to, a verbal communication came before the board at the last meeting on Wednesday and we very naturally desired that it should be put into writing. That writing only reached our general manager on Monday last, and of course has not come before the board since, as the board has not met in the interval, I, therefore, do not feel in a position to discuss the question. Mr. Lane-Fox has had my sympathy in his grievances, for to him belongs the honour of having been the first to foresee and solve the difficulties which surrounded the problem of producing a good incandescent lamp.

The following resolutions were then unanimously confirmed:—

"That it is desirable to re-construct the Anglo-American Brush Electric Light Corporation, Limited, and that with a view thereto the corporation be wound up voluntarily, and that J. B. Braithwaite, jun., and E. Garcke be, and they are hereby, appointed liquidators for the purposes of such winding up."

"That the said liquidators be, and they are hereby, authorised to consent, if required, to the registration of a new company, to be named 'The Brush Electrical Engineering Company, Limited,' with a memorandum and articles of association which have already been prepared with the approval of the directors of the corporation, but which are to be subject to such alterations and modifications (if any) as may be found expedient."

"That the draft agreement submitted to this meeting and initialled by the chairman for the transfer of the business and property of this corporation to the new company shall be and the same is hereby approved; and that, pursuant to section 161 of the Companies Act, 1862, the liquidators shall be, and they are hereby, authorised to enter into an agreement with such new company (when incorporated) in the terms of the said draft, and generally to carry the same into effect, with such (if any) modifications as the liquidators may find expedient."

Falcon Engineering and Car Company, Limited.—A meeting was held yesterday at Coleman Street to confirm the arrangement with the Brush Company. The proceedings were entirely of a formal character, and lasted a few minutes.

TRAFFIC RECEIPTS

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of July were £5,350.

THE LAW OF PROBABILITY OF ERROR AS APPLIED TO THE OBSERVED ELECTRICAL RESISTANCE OF THE HUMAN BODY.*

By A. E. KENNELLY.

IT is generally admitted that all social phenomena are in the aggregate controlled by the general law of probability of error, and statistics, it is claimed, show that the proportions, weight, intelligence, and, in fact, all measureable properties of animated beings, at any given time or place, centre about some mean value, the divergencies from which follow the law of probability of error in observations. This leads to the inference that nature endows all organisms with slight variability of type in a high degree, any one quality being the resultant of a great number of factors, so that the general mean is reached through the summation of all possible variations of those factors, as many variations being ultimately positive as negative. The law has probably not been stated for the measured electrical resistance of the human body, but the following observations may fairly be said to indicate its application:—

Two hundred and twenty men and boys were measured at Mr. T. A. Edison's laboratory for the resistance they offered between the hands with liquid contact. The measurements were all made on the same day, and as nearly as possible under the same conditions. Two glass jars, 15 centimetres (6 inches) in diameter and 20 centmetres (8 inches) deep, containing an aqueous solution of caustic potash (density 1·10), were connected by immersed copper sheets, 15 centimetres × 29 centimetres (6 inches × 15¼ inches), with a Wheatstone bridge. The reason for adopting caustic potash solution was that in a previous test with 39 men their mean resistance between the hands immersed in this solution was found to be 30 per cent. less than when aqueous zinc sulphate solution, of density 1·13, and zinc electrodes were used, all other conditions remaining unaltered.

The testing battery had a low resistance and an E.M.F. of 8 volts. The bridge ratio was $\frac{1000}{1000}$, and with the dead beat galvanometer employed, readings could easily be taken to one ohm in 2,000.

The measurements were made in such a manner as to eliminate almost entirely the effects of polarisation. Under these circumstances it was found that between the limits of the feeblest current by which an observation could be obtained and the strongest current that on starting or interruption could be conveniently supported by the men (about five milliampères), the measured resistances were practically independent of the current strength, and, consequently, of the battery power employed. The resistances, however, decreased with the surface area of immersed skin, and also with the period of immersion, in many instances falling about 100 ohms in the first 30 seconds. To obtain comparable results, therefore, the hands of the person tested were plunged, pointing vertically, downward in the jars until the tips of the middle fingers rested on the bottoms, and the measurement was made as closely as possible 30 seconds after immersion. The readings were carried to the nearest 10 ohms, units being negligible even if the resistance had been steady enough to render them distinct. The variations in these measurements would include not only differences in the resistance of the arms and trunk, but also the variations of thickness in the epidermis, area of hand surface, as well as errors of observation and time. All these disturbing conditions, however, may be regarded as belonging to the class of observational error, and simply tend to make the measurement of the resistance within the body less precise. The age, height, and weight of the subject were recorded with each observation. No dependence of the resistance upon these qualities could be noticed, but the boys had apparently a higher resistance and stoutly built men a low resistance. Thus the four boys of ages under 16 gave an average of 1,218 ohms, while the nine cases of men, whose weight exceeded 175 pounds, gave an average of 770 ohms.

The average of all the 220 measurements was just 1,000 ohms, and the sum of the divergencies from this mean value taken without regard to sign was 27,920.

From these data we obtain by the application of the usual approximate formulæ of probability the following table in which the actually observed and calculated divergencies are compared.

Divergence between.	Calculated number of cases.	Observed number of cases.	Difference.
0 and 50 ohms ±	54	47	7
50 ohms and 100 ohms ± ...	49	56	— 7
0 and 100 ohms	— 103	— 103	—— 0
100 ohms and 150 ohms ± ...	41	38	3
150 ohms and 200 ohms ± ...	30	40	—10
100 and 200 ohms ...	— 71	— 78	— —7
200 and 250 ohms ±	20	13	7
250 and 300 ohms ±	13	10	3
200 and 300 ohms ...	— 33	— 23	— 10
300 and 350 ohms ±	7	7	0
350 and 400 ohms ±	3	1	2
300 and 400 ohms ...	— 10	— 8	— 2
400 and 500 ohms ±	2·6	4	—1·4
Over 500	0·4	4	—3·6

The agreement is seen to be very fair, except that there were more large discrepancies of over 500 ohms than theory would account for.

The highest observed resistance was 1,970 ohms and the lowest 660 ohms.

Under the conditions of this test, therefore, it was an even chance by the theory of probability that any man's resistance would be within 108 ohms of 1,000, *i.e.*, would lie between 892 and 1,108. As a fact, 115 out of the 220 observations fell within those limits, so that the final result of all the measurements was 1,000 ohms ± 108.

* *Electrical World.*

THE TELEPHOTE.

[*From the Indépendance Belge.*]

EDISON'S arrival has stirred the scientific world of Paris; this astonishing *savant*, whose brain, disdaining the twelve labours of Hercules, has introduced 610 inventions, comes to France bearing in the folds of his mantle an innovation which has already been much spoken of—I refer to the telephote. I must add that the telephote is already claimed by a young French *savant*, M. Courtonne, who, moreover, has drawn up a report carefully enclosed in a sealed wrapper and confided to the care of the Academy of Sciences. M. Courtonne has worked at his discovery for about five years, and he does dream of being wronged in his rights by Mr. Edison, who has many other glorious titles to his name.

This is what, according to M. Courtonne's own explanations, the telephote consists of:—It is an apparatus which consists in transporting sight to a distance; it is not naturally the question of a telescope, as that would not offer anything very original as a discovery. The visual ray will be simply transported to the place it is desired to contemplate by electric wires which will be attached thereto; thus Marseilles being united to Paris by these wires, one could, so to speak, transport his eyes to the Cannebière and follow without effort everything passing at that point.

M. Courtonne avows, however, that he has not yet made experiments up to so great a distance as that which separates Marseilles from Paris, but that he has already extended his radius of action up to about 200 kilomètres, and that before three months he engages to solve the problem for even greater distances. Edison, who does not ignore M. Courtonne's works, has written to his young *confrère* to announce his arrival and asking for an interview. It will be, I think, a moment of inexpressible emotion when these two *savants* mutually communicate their researches and examine together if they have arrived at the same result by different means, or even if there is between their labours a quite fortuitous coincidence. In a fortnight the learned world will be fixed on this question.

It may be said that the day when this invention shall have received an official application (and we have every reason to think that the interview between MM. Edison and Courtonne will accelerate this result), there will be produced to a certainty a profound commotion in human life, from which industry, strategy, the Press, and everything playing a part in human mechanism will draw an inestimable profit. One believes he dreams when he thinks that one day the eyes will plant there the human body, and will go travelling incognito in different places they are ordered to explore.

ELECTRIC LIGHTING IN LONDON.

BILLS BEFORE THE LORDS' COMMITTEE.

(*Continued from page* 154.)

You have had experience of supplying lights in London. What is about the number of lights you could supply at the present time?—We have supplied about 33,000, but we have about 30,000 on at the present time.

That has been done by wayleaves and by the privilege of the owners of property?—It has so far been by the good will of those whose property we go over.

Is this transformer doing on a larger scale the same kind of work as has hitherto been done by the alternating current?—Identically the same.

It is put forward here that one of the objections of the St. James's and Pall Mall Electric Lighting Company, who are opposing your Bill, is that they are already supplying current. Is it not true of yourself that you are supplying current in St. James's?—Yes, we have been doing so for some time. We are supplying about 6,000 lights in St. James's.

I have looked at the petition of the St. James's and Pall Mall Company and find that substantially they claim a monopoly over that district. They say that they are able to light the whole, and they claim that you should be excluded. What is your answer to that under the Act of Parliament?—Parliament says that where there is any difficulty of deciding what is the best course to be taken there shall be a local enquiry. The Board of Trade have held that enquiry, and the recommendation of the inspector was that there should be two companies for each parish—one with the alternating and the other with the direct current. So far as I understood the reason for having the two systems in one district was because at that time it was urged that the alternating current could not be used for motive power. I disputed that at the time of the enquiry, and endeavoured to show that it could be used for motive power.

There was no alternating current motor then in the market?—That is so; but we have them now.

And your answer to that part of the petition is that you have submitted yourselves to the decision of the Board of Trade?—Yes, and I am totally opposed to a monopoly.

And they also allege in their petition that, having laid down mains, they will be prejudicially affected by your undertaking; was that gone into at the time of the enquiry?—Yes; they will not be affected in any way except that they will not get so much lighting. The competition is the only injury to them.

At the time of the enquiry they had laid down but very few mains?—None at all.

But having pushed on perseveringly since they can now show they have put some down?—Yes.

They also cast some reflections as to the sufficiency of your capital?—Yes; I do not know that I need go into that. I very seriously dispute their allegations.

Then, in one paragraph they say of your system that it "is not only uncertain but also dangerous to life and property, and, furthermore, a system that cannot be efficiently utilised for motive power or for electric deposition or other chemical uses." Has not that all been threshed out before the Board of Trade?—Yes.

Mr. BIDDER: What do you mean by thoroughly threshed out? We are here to discuss it.

Mr. LOYD: Of course, I cannot suggest that the Committee are bound by that; but I mean that it is no new point. If necessary, I can point to the evidence of Sir William Thomson.

Mr. BIDDER: Oh, but you cannot refer to the evidence. You can call Sir William Thomson if you like.

Mr. LOYD: I only say that to show how the land lies. (To the witness): You are also opposed by the City of Westminster Electric Syndicate?—Yes. The WITNESS continued that when the corporation in July of last year applied for a provisional order and gave notice to the local and other authorities no objections were taken by the syndicate, nor did they appear before the Board of Trade. The parish of St. Margaret's and St. John's, Westminster, was essentially a portion of the corporation system. They had received requisitions for the supply of a very large number of lights in the parish.

Cross-examined by Mr. BIDDER: You have not erred on the side of modesty as to the power you have asked from Parliament.

The WITNESS: We have reduced our original requirements by one-half.

By the map, their lordships will then see that your original requirements included nearly the whole of London?—There were thirty-eight local authorities comprised.

The list of areas in the Bill represented about half the population of London?—There or thereabouts.

Am I to understand that having gone to Deptford for a central station, nothing less than the half of London would make it pay?—No; I do not think you can fairly put it that way. That is carrying it to excess.

Your capital is £1,000,000?—No, a million and a quarter.

At present you are supplying about 33,000 lights?—About 30,000 at present.

And to supply the whole of this district—if the supply became general—would, in your estimation, require how many lights?—I could not tell you straight away, because a good many persons would not require the light at first. If you only want some idea of the number, I would say that, practically speaking, there will be one light required for every head of the population. But it will take a long time before it comes to that.

That would be 2,000,000 lights?—Yes.

At the present moment you have spent £400,000 of your £1,250,000?—Yes.

And you have only 30,000 lights?—You must not put it in that way. We have now a station finished, and two engines of 1,500 horse-power finished; and at the end of this year we shall have two engines of 10,000 horse-power.

Do you put it to their lordships that £1,250,000 would suffice to provide all the stations, plant, mains, and services adequately, to fully supply the lighting of the whole of the district?—No. I think I might ask a similar question of the St. James's Company.

I think you might very legitimately, if I proposed to do anything like what you propose. May I take it that 4 or 5 times your present capital will be necessary to supply the whole of this district?—No, no.

Say three times?—£3,750,000?—Yes; that would do very well for us.

I mean would that adequately accommodate the whole area you are seeking powers for?—That is rather a big estimate you ask me to make straight off. I believe we could put down machinery to distribute lights at the rate of from £1 to 22s. 6d. per light.

That would be about double your present capital?—Yes.

What did you contemplate, supposing your order was granted in the first instance—would it be to go through the districts and take the *élite*—the cream of the custom?—No, I think not. We were very tightly tied down by the orders.

The Board of Trade have put upon you conditions as to laying in certain streets which you wish to avoid?—Most of them which you mention are streets which I should have selected. There was an obligation that we should be compelled to lay down where it was required within 18 months, and I asked that the time should be extended to two years.

Your system differs from ours, inasmuch as it does not provide for motive power?—It was stated at the enquiry that the alternating current would not do for motive power; but I said then I could show that was an error. It was not then demonstrated, but it has been since.

And I think, Lord Crawford, the ground upon which the Board of Trade approved and sanctioned the two companies within the one area was that the alternating company would not supply motive power if it was wanted?—But that is no argument against ours, surely.

Let me judge as to whether it is an argument; but, as a matter of fact, was not that the ground upon which the Board of Trade had advocated and sanctioned the two companies in the one area?—It was *a* ground.

Now, if you are right, that ground no longer exists, because it is a delusion to suppose that the alternating current cannot do this. You do not, therefore, want two companies—the one to supplement the other?—I really do not know how I can answer you.

So far as that was the ground for the two companies, it exists no longer, if your theory is right?—It exists no longer against us.

Or against anybody. There is this difference between your system and ours—that the current in use in our system is relatively very low in tension, whereas yours is tremendous in tension?—Your currents are, I believe, at a tension of 120 volts.

And yours are, I think, 10,000?—Not for distributing. We have a trunk main for the high tension current, but the ordinary distribution of electricity to the different houses from distributing stations is at 2,400 volts.

Do your currents kill persons?—A current of 10 volts would kill sometimes.

But, as a matter of fact, your current from your main trunk, or even from your secondary trunk main, would kill anybody who came across them?—Well, there is a difference of opinion. I think it would not. It might kill some persons. It would kill anyone with heart disease.

Our currents would not kill anybody?—I do not think they would.

There was a man killed by one of your currents?—Yes; but it was a naked wire.

This transformer—this machine which is to be used will "turn the lion into the lamb?"—I know the expression very well.

If anyone came across that would it hurt them?—No, it would not hurt anyone. A person could sit on it if it was properly constructed.

Has there been any experience of this 10,000 volt current having any effect upon any other electrical mains?—I do not quite understand. Do you mean as regards——

I mean in any way?—There has been no working of any mains I am acquainted with with a pressure of 10,000 volts in the streets.

As to your position in St. James's, I gather that your company has bought up Sir Coutts Lindsay at the Grosvenor?—Yes.

And that installation was to be swept away by direction of the Board of Trade?—They never said so.

Did they not insist that the overhead wires should go?—That is the case with anybody having overhead wires.

How many lights do you say you had in St. James's—6,000?—I cannot tell exactly; my impression is that it is between 5,800 and 6,000.

Have you not quite enough to do for the next three or four years without going into St. James's?—No.

For the purpose of laying trunk mains you would be allowed to go through the district?—That is my view of the case, but it is a matter of dispute. Some authorities think not.

Take another of your districts. Are you going to set to work at Chelsea at once?—We are.

Have you found any restrictions in Chelsea?—We have arranged any differences.

Why do you want then to go into our preserves?—It is not a preserve.

Are you not quite ready to deal with us as you have done with the Chelsea Company?—No; you ask us to clear out altogether.

I say at once we do not. The places that you are now supplying I say it is only reasonable that you should continue to supply; but looking to the enormous work and area you have to cover, don't you think we could come to terms by putting the St. James's on the same footing as the Chelsea?—I do not see why it should be so at all.

What is the objection to treating us in the same way. What is fair for the one is fair for the other?—No, I beg your pardon.

If I mistake not you have the City supply?—No.

Have you tendered for the supply of light in the City, and has it been accepted?—That I cannot say. We have tendered, but it is put back until after the holidays.

Don't you think you could leave alone active competition with us for the next four or five years?—I am sorry I cannot.

What is there so attractive in our district which makes it impossible for you to postpone your attack upon us?—I think the natives would object.

I think the natives have been rather leaving you and coming to us?—In two cases only.

Cross-examined by Mr. BATTEN the WITNESS said that his company did not supply any lights in Westminster. He should certainly have the strongest possible objection to simply running through Westminster and leaving the supply of the district. Already the amount taken away from them by the Board of Trade represented over 10,000 lights, with an annual rent of many thousands of pounds, and therefore he could not consent to any further reduction of his order.

In answer to Mr. LOYD the WITNESS stated that with the plant already in position at Deptford they would be able to supply 450,000 lights. When they got into a district the light created its own demand. Their station was capable of duplicating and re-duplicating the number of lights.

Mr. LOYD: What would be the total capacity of the Deptford station?—The total capacity would be about 2,000,000 10-candle lamps.

Who were first in the area—yourselves or the Pall Mall Company?—We were there long before them.

Can you suggest any reason why you should now clear out and give them a three years' start?—No, certainly not.

I understand that an agreement has been made between you and the Chelsea Company as to you not supplying their area unless requisitioned?—Yes, we voluntarily came to that arrangement.

Coming now to the united Parishes of St. John and St. Margarets, Westminster, can you suggest any reason why you should clear out of there?—No, I don't see any reason at all. But I don't object to the Pall Mall Company being there.

Mr. LOYD said the next witness he would call was Major Marindin.

Mr. BIDDER suggested that as Major Marindin had made a report on the matter all that was necessary was for that report to be put in.

Mr. LOYD stated that at the previous inquiry he intimated that he would let Major Marindin's report speak for itself, and objection was made that the inspector was not called.

Mr. BIDDER remarked that such an objection was certainly not raised by him. It struck him (Mr. Bidder) that it was a little contrary to usual practice that a gentleman who had been in the position of a judge in the matter, and who had delivered his judgment, should come before their lordships as a witness. He should therefore formally object to Major Marindin being examined.

Mr LOYD: I claim a right to call Major Marindin, and to ask him questions generally.

Mr. BATTAN also objected to Major Marindin being examined.

After consulting with his colleagues, the CHAIRMAN said the committee were clear that it was quite competent for Mr. Loyd to call Major Marindin, and it would be for the witness to take any objections to any questions he might think it best not to answer.

Major MARINDIN, who said he was there by order of their Lordships' House, was then examined by Mr. LOYD, and stated that he was the inspector upon whose report the provisional orders now under discussion were made. These orders, he said, were decided upon after an inquiry which sat for 18 days.

I believe that no fewer than 13 provisional orders were applied for, and that there were two applications for licenses?—Yes, that is so.

The local authorities have, I believe, all appeared before you?—A number were represented, and some were not. Some sent counsel, while others were only represented by their vestry clerk.

With regard to the various conflicting applications, did you find it necessary, in order to allot areas to the different companies, to adopt districting, coupled with limited competition?—I considered that districting was necessary when there were two alternating companies in the same district. Where a parish agreed to the entrance of electric lighting companies into their area, I thought it desirable, for the present, to limit the companies to two.

One of those large alternating companies was the London?—Yes; one was the London and the other the Metropolitan Company.

Mr. BIDDER: I must object to these questions. They are simply asking the witness what is the effect of his report.

The CHAIRMAN overruled the objection.

Mr. LOYD (to the Witness): The St. James's and Pall Mall Company appeared before you and objected to the two orders?—Yes; both to the Metropolitan Bill and to that of the London Corporation.

I believe you allotted to the London Company the St. James's area. Did you take into consideration the fact that the St. James's Company were already there by licence, and only let one other company into the area to compete with them?—Yes.

Was there any reason whatever, in your judgment, why the London Company should have their wires in St. James's confiscated?—That never entered into my head at all.

With regard to St. Margaret's and St. John, Westminster. Is it true to say that your intention was to keep the London Company from doing anything more than going through that parish?—Certainly not.

Is it your opinion that the area allotted to the London Company is essential to their system as a whole in the metropolis?—I found that the London Company, having generating stations on the south side of the Thames, could not get across without an agreement with the railway companies. I thought that in order to preserve the continuity of their supply they ought to have an alternative route of getting over the Thames, and I therefore included the route of Lambeth and over Westminster Bridge.

Cross-examined by Mr. BIDDER, the witness said that two districts had been added to the London Company to make their area continuous.

This company—the London Company—being essentially a company for the south side of the river, might just as well have confined their operations to that place?—No, because they are actually supplying a large portion of the north side of the river, and they were simply transferring their generating station to the south side of the river.

The second principle upon which you have gone in allotting the various areas is that there should be two companies everywhere?—Well, I think it is desirable there should be two companies, but not everywhere. Supposing the local authority did not wish to have any companies in, then I only put one in.

As a matter of fact, the local authorities of St. James's appeared before you and protested?—They appeared before me to oppose, and at the same time the representative of the vestry said that if the company would consent to certain suggestions of the vestry they would let them come in.

Well, as a matter of fact, those conditions of the vestry were not conceded by the promoters?—I think they were.

I am told distinctly that they never were?—I think the company met the vestry very fairly in the matter.

Do you know what the conditions were?—The conditions were the insertion of certain clauses, and, as I say, I think the vestry were very fairly met.

I think you said that you found the London Company supplying both in St. James's and Marylebone, and that the Metropolitan Company had agreed with Marylebone so that it was necessary to turn out the London?—No. It was necessary in districting between the two to allot Marylebone to the London.

One of the conditions of the vestry was as to price?—Yes.

Do you recollect Lord Crawford saying in his evidence that he was not willing to come under the same conditions in regard to price?—I don't remember that.

In your report do you express any opinion as to the relative merits and advantages of the continuous current and of the alternating current systems?—Yes, I do express in my report what the advantages of the two systems are.

I see you point out in your report in rather distinct language what appeared to you to be the advantages of the high pressure alternating system?—Yes, I think I do.

May I take it that you are strongly in favour of the continuous system?—I think that from a consumer's point of view there is no system which will give such a good supply as the direct current and storage batteries. But the evidence brought before me showed that in some large areas the transformer system had its advantages. I do not mean the continuous system, as supplied by the Pall Mall Company, but that as supplied by the Chelsea Company with storage batteries. That, I believe, is the best. I also think that a large company is much more likely to supply the light satisfactorily than a small one.

You have recommended eight or nine orders, all of which are considerably smaller than this. Therefore you don't consider a large area is absolutely necessary to make a remunerative concern?—No, I believe that a company can work a small area profitably.

Mr. GRAY then rose to cross-examine the inspector on behalf of the Board of Trade.

Mr. LITTLER said he objected to the Board of Trade interfering in the matter at all. They had no *locus standi* and therefore he objected to Mr. Gray taking any part in the committee.

Mr. GRAY said the orders they were discussing were made under the Act of 1882, and similar orders were made in 1883, and on those occasions the Board of Trade was represented by counsel before both Houses of Parliament, without demur. He was instructed by the department he represented to say that they were also represented by counsel in regard to the tramway orders, which was on all points with the present orders. It should be remembered that not only had the Board of Trade the drawing up of the provisional orders but they would also have the administration of them hereafter. Altogether, they would have a great deal to do with the

carrying out of the orders and he submitted that it was very undesirable they should not be heard in the matter.

Mr. BIDDER also took exception to Mr. Gray representing the Board of Trade. Mr. Gray was not promoting, nor was he opposing, and therefore he should like to know in what capacity he had a right to appear.

Mr. GRAY said that in a certain sense the Board of Trade were there in the capacity of promoters, as the Bills were brought into the House of Commons by the President of the Board of Trade, and in that capacity he was responsible for them.

The CHAIRMAN having cleared the room, debated the matter with his colleagues for some time. Upon readmitting the public the Chairman said the committee considered the point was so important that they would defer their decision until the next day.

The proceedings then adjourned.

August 8th.

The Committee to-day proceeded with the consideration of No. 2 Bill—that of the Westminster Electrical Supply Corporation, Limited.

Mr. FREEMAN stated that, subject to the preamble of the Bill passing, he had agreed with Mr. Saunders as to the clause with reference to the bridges. They would leave the order as it stood, except that to the first schedule as to the area of supply they would add the following: "excluding the following bridges over the river Thames vested in the County Council, viz., Westminster, Lambeth, Vauxhall and Chelsea."

Mr. SAUNDERS then resumed his address, specially dealing with the petition of the opponents of the order, viz., the City of Westminster Electrical Syndicate. He said that exception was taken as to the capital of the company, but he believed their lordships would be perfectly satisfied when he mentioned the persons who would find the capital of the company. For instance, there was Lord Suffield, who had already promised to take 250 shares, and meant to take a larger amount—possibly another £5,000. Then there was Mr. Hayes Fisher, M.P., £5,000; Sir John Heron Maxwell, Bart., M.P., £5,000; Mr. Brown Martin, the chairman of the company, and a large owner of property in Westminster, who, with two other gentlemen, paid £9,000 a-year in rates in the Parish of St. Margarets and St. Johns, Westminster, which proved the *bona fides* of these gentlemen. Mr. Martin's name would be down for £50,000; Mr. Henry Kimber, M.P., for £5,000; Mr. Arthur Baker for £5,000; Mr. Edward Vigers, £5,000; Mr. G. Richardson, £5,000; Mr. R. Wallace, £5,000; Mr. D. P. Sheridan, £5,000; Mr. R. Fowler, £5,000; Mr. James Lateire, £5,000; Mr. David Pinner, £5,000, and others had taken a small interest, but he believed they were prepared to largely increase their holdings. It was not at all likely that the order would be revoked, for already £10,000 had been spent in putting up works which were actually necessary to supply the first demand for electrical energy. The petitioners stated that they had a long lease and a valuable site for a new central station, and he supposed they had, if they said so, but he wished to point out that he believed it was the same site that his company had refused, and that there were a number of restrictions and conditions of the most onerous character attached to it. But that was no justification for their trying to stop the public from getting the benefit of the light from another company. Then there was the question of having a special report of the Board of Trade as to the consent of the Vestry.

The CHAIRMAN: That is a matter of fact which is not now argued.

Mr. LITTLER: Is that the unanimous opinion of the committee?

The CHAIRMAN: It is the unanimous opinion of the committee that it is not an arguable matter on the question before us.

Mr. LITTLER: If your lordships think so, then I have nothing to say on that point.

Mr. R. E. CROMPTON was then called, and, examined by Mr. SAUNDERS, stated that he was managing director of Messrs. Crompton & Co., electrical engineers, and president of the electrical section of the London Chamber of Commerce. He had had experience of putting up central stations. He commenced the supply of electricity for a central station in 1883—the first year in which provisional orders were granted, and he supplied all the central stations of the Edison and Swan Company, for which four provisional orders were applied for and obtained in 1883; and he made all the designs and calculations necessary for him to give evidence before a committee of the House of Commons and their lordships. He had had experience in electric lighting at Kensington by licence under the Board of Trade. He had been the engineer of the Kensington and Knightsbridge Company, and was responsible for the whole of the designing of the plant of that station, which was a successful one. There were no overhead wires at Kensington and Knightsbridge, as the electricity was entirely distributed by underground mains. For the last three years the company had been supplying current. He was called upon by the directors of the Westminster Company to prepare designs for plant at their station in Baker Street. It was to be prepared in two portions—the first portion to be sufficient for a maximum supply of 5,000 lamps of 10 candle-power each, and the second portion to supply 85,000. The second portion was for the lower half of the district, for which an order was applied for. They had carried out more than half the first portion—that was to say, they had put down a large portion of the plant on a scale sufficient for 5,000 lights, and most of the remainder could be increased up to the 5,000 limit in the course of a few days, because it only meant putting down a few additional dynamos and engines. The boilers required for the number of lights were in position, and had been tested. All the machinery had been tested and was at work, and there was a large battery for accumulators which had been put up, and all the switchboards and plant required for the central station were in position and practically ready for work. About three-fourths of the work necessary for the 5,000 lights had been completed. He had inspected the works of the syndicate, and as far as he could judge, it appeared to him that the quantity of boilers and machinery put down was all very well as a temporary means of supply, but he did not think it was sufficient to supply the necessary amount of light require to make a central station pay.

Mr. SAUNDERS: With regard to carrying away the smoke and excess steam from the respective works, which do you consider the better plan?—At present there are no appliances at the Westminster Syndicates' premises to carry away the smoke and steam.

The Westminster Company have an excess pipe which goes to the farther end of the very large building?—Yes.

As to the work done by the Westminster Company is it of a permanent nature only?—Most of it is, but there is a certain portion which could be transferred to another building.

And what is about the value of the plant you have put down?—The value of the plant itself is about £5,000. The witness continued that as a director of the company he had satisfied himself of the *bonâ fides* of the promoters and the responsibility of the undertaking.

Mr. LITTLER: You do not light a single lamp at the present time?—We have not commenced. In reply to further questions the witness stated that he had visited the works of the Westminster Syndicate and found that they had four boilers there. He had not made a calculation as to how much had been spent on the site. The Westminster Company had spent perhaps about £2,500 on machinery. The size of their engine room was 45 feet by 13, but the new engine room was about 45 feet by 24.

Mr, LITTLER: We have put it at 25 by 13, and I think we have measured it. (Laughter). To the Witness: Both of your boilers are secondhand, are they not?—No, one is new. One is a 20 horse-power boiler, and the other is a 40 horse-power. They were set about six weeks ago.

Is the maximum output 800 lamps of 10 candle-power?—Do you mean engines and boilers?

I mean all your present appliances?—The maximum output is about 1,200.

Mr. SAUNDERS stated that he did not object to going into those details if their lordships thought that they should be gone into, but the points were not raised in the petition, and therefore he thought they ought not to be gone into.

Mr. LITTLER claimed to deal with the whole of those matters, and thought their lordships would be interested in knowing, before he was suppressed, that his company was actually supplying light and the other was not.

Mr. SAUNDERS: You are not suppressed.

Mr. LITTLER: We are practically suppressed, for you are a Parliamentary company and we are not.

The CHAIRMAN then asked Mr. Littler what paragraph in the petition gave him ground for going into these details.

Mr. LITTLER stated that he referred to the paragraph which stated that the Westminster Company had not yet produced, either to the local authority or at the Board of Trade enquiry, any proof that they had any funds sufficient to enable them to efficiently carry out the supply of energy to the district they sought to make their own.

After consultation with his colleagues, the CHAIRMAN said the Committee were of opinion that Mr. Littler was entitled to raise the question.

Mr. LITTLER then continued the examination of the witness upon the question of the founders' shares of the company, and asked whether he knew of any case in which Parliament had sanctioned founders' shares.

The WITNESS: No.

Do you know what those gentlemen—Mr. Brown-Martin, Mr. Kimber, Sir John Heron-Maxwell, and others—have done to entitle them to these founders' shares?—No.

What is a founder?—I always understood a founder as one who takes a great deal of trouble and risk in the early stages of a company, and that he is entitled to something in return and to some deferred benefit hereafter.

Can you tell me what amount altogether has been laid out by your company on this station?—I cannot tell you exactly, but for the total plant we have paid about £4,700.

If you supply underground you have no power to break up the streets until you get an order?—Or a licence.

In point of fact, it all depends upon what happens here to-day. Unless you get your order it is not worth much?—But we can go on without it.

At all events, the gentlemen who have been spoken of will not lose anything, and they are not bound to take these shares?—I do not know what arrangements have been made.

(To be continued.)

Personal.—Mr. H. A. Henderson has opened a practice as consulting electrician and electrical engineer at 20, York Chambers, Brazenose Street, Manchester.

THE ELECTRIC LIGHTING SCHEMES.

Bills before the Commons Select Committee.

(*Concluded from page* 165.)

Upon the Select Committee resuming their inquiry,

Mr. ALBERT GRAY (on behalf of the Board of Trade) desired to first make a few remarks which he believed would be of assistance to the learned counsel for the gas company. He had not thought it proper or necessary to interrupt the proceedings the previous day, but that morning one of the proposed new clauses was put into their hands, and it was then considered necessary that the views of the Board of Trade upon it should be laid before the Committee, as they were asked to give their decision as to the clauses. In the first place, as to the question of what notice should be given to the gas company before any trench was dug; the Board of Trade had no objection to the extension of the time of notice. Then, as to undermining and the support to be given to the works, the Board of Trade had no objection to that if the Committee thought it was necessary to insert an amendment to that effect. Another suggested amendment was as to the insulation of the wires. The Board of Trade did not object to that, provided their powers to make regulations as to the supply to and the safety of the public were safeguarded. But the clause proposed by the gas company contained another provision which the Board of Trade could not assent to. That provision was as follows:—

"The owners, upon giving notice to the undertakers during the 14 days of their desire to execute any work to which the provisions of this section apply, may themselves execute the same; and in case they give such notice, they shall execute such work with due care and diligence, and shall be subject to the like restrictions and conditions as the operators would themselves be subject to in respect of the same, and the reasonable costs of executing such works shall be repaid by the operators to the owners: provided always that the provisions of this paragraph shall not apply so long as any notice from the County Council, the local authority, or other body or person under the provisions of section 15 of this order remains in force."

Mr. GRAY said he gathered from the chairman's remarks on Thursday that it was in his mind that the reciprocal working provisions as between the two companies in the case of alteration of pipes, which provision was contained in clause 16, did not appear in clause 17. But there was a reason for that. By the 4th Section of the Act of 1882 the Board of Trade might "by provisional order authorise any local authority, company, or person, to supply electricity," and it went on: "but in all other respects subject to the provisions in the last section contained with respect to licenses." The provision of the preceding section was as follows: "Where in any area, or part of an area, in which any undertakers are authorised to supply electricity under any license the undertakers themselves are not the local authority the license may contain any provisions and restrictions which the Board of Trade may think expedient for enabling the local authority to exercise any of the powers of the undertakers under this Act with respect to the breaking up any street repairable by such local authority." That section authorised reciprocity only between local authority and the undertakers. Section 15 of the same Act contained powers for reciprocal working as to alteration of pipes, &c. If they got their streets broken up, and the trenches dug, and had got down to the pipe sufficiently to remove it, then the owners of the pipe were to have the option of removing the pipes if it was thought necessary for the undertaking that they should be removed. But the Electric Lighting Act and the enactments incorporated with it gave the Board of Trade no power whatever to authorise the gas company to break up the streets for the purposes of electricity. The powers given to them were confined strictly within the four corners of the Act. He desired, therefore, to point out to the committee the course which the Board of Trade would be compelled to take if the proposed new clause as to breaking up the streets were sanctioned. It would be a power which the Board of Trade would never use, and they would never insert the clause in any license because it would be *ultra vires* on their part to do so. They would never insert it in any provisional order because they had not the power to grant it, and, in every case, far from this being hereafter a model clause for provisional orders, as Mr. Pope had said, it was a clause which would, in every case, have to be inserted in committee, and the Board of Trade would not sanction its insertion hereafter unless some Act of Parliament was passed authorising or requiring them to do so. There were other considerations with regard to the conflict between that clause and the clauses enabling the local authority to do the work which he thought would meet with much difficulty. It seemed to him that there would be great difficulty arising from giving that double power for reciprocal working to the local authority on the one side and the gas company on the other.

Mr. PEMBER thought that now they had heard the views of the Board of Trade, it would be better for the counsel to retire and see if they could not agree to a clause which would satisfy all parties.

Mr. BIDDER felt bound to say that the Board of Trade had not very happily or very perfectly apprehended what was done by the counsel the previous day. The reciprocity agreed to had nothing to do with the option of the different parties doing work. The intention of the reciprocity was that the Gas Company should be allowed to do the gas part of the works and the electricity companies do the electrical parts of the works.

Mr. FREEMAN observed that the clause as now introduced by the promotors was inconsistent with the requirements of the London County Council.

The counsel then retired to consider the point raised by Mr. Gray, and upon returning

Mr. FREEMAN said that he had been excluded from the conference.

Mr. PEMBER remarked that that was so, because the question was one as between the Gas Company and the electric lighting companies only. So far as his company was concerned they had agreed with the Gas Company to the clauses which were the subject of consideration the previous day. The view the London Company took was, that there was no reason why the Board of Trade should object to the clause. So far as he understood it they had brought forward certain clauses in the principal Act which it was said limited the power of the Board of Trade to grant provisional orders, and that it would be *ultra vires* on the part of the Board to consent to the additional clauses. If that were conceded he should ask the Committee if they deemed the new clauses wise in themselves to say that Parliament in dealing with the question of laying down electric wires in the metropolis and in settling matters between the gas and electric lighting companies was not bound by the limitations which had been imposed upon the Board of Trade. They could amend a provisional order and confirm it so amended, and therefore he proposed to ask the committee if they thought the clauses were wise under the circumstances—and he hoped that a certain amount of recommendation would induce the committee to believe that they were wise—to agree to put them in. And even if it were *ultra vires* on the part of the Board of Trade to grant an order with them, he would ask the company to consent to put in a recital to the effect that the orders had been amended by Parliament in committee and that Parliament confirmed the orders so amended. The committee would of course listen to the Board of Trade arguments if they could show that they were not wise, but the mere technical objection that it would be *ultra vires* on the part of the Board of Trade did not apply to Parliament.

Mr. POPE quite agreed with Mr. Pember, and added that, of course, the powers of the Board of Trade to grant provisional orders were limited within the four corners of the Act by which they had their power; but there was no limit to the powers of Parliament. If the committee confirmed the general terms of the order, without stating in the preamble that Parliament had amended it, hereafter it might be contended that they confirmed only that which was strictly within the authority of the Board of Trade. But that would be cured by a recital in the preamble as suggested by Mr. Pember. The counsel for the gas and electric companies had arrived at a very happy solution of their differences, and had agreed as to what clauses would be reasonable for the protection of the gas companies. It would be a wise thing, therefore, for Parliament to accept that which was agreed upon between the two interested parties, and to cure any mischief of anything *ultra vires* on the part of the Board of Trade by simply reciting that the amendment had been made with the authority of Parliament.

Mr. GRAY did not question the power of the Committee to act as suggested in an extreme case. But such a provision the Board of Trade would not be entitled to insert without the authority of Parliament.

The CHAIRMAN: Do I understand that that point is settled, and that by so amending the Bill we impose this duty on the Board of Trade?

Mr. POPE: The amendment will be the work of Parliament, and not of the Board of Trade.

Mr. GRAY: I quite understand that the matter is now removed from the Board of Trade, and that they are not responsible for the alteration.

The CHAIRMAN: I conceive that the insertion of this condition only resembles the insertion of other conditions which are not mentioned in the Act. I do not see why our powers are limited in this respect.

Mr. GRAY: When the subject of the electric lighting was before the House and Committee, the powers of the Board of Trade were carefully considered.

The CHAIRMAN: If Parliament on consideration of the Bill thinks this an undue provision, they will strike it out.

The question of additional clauses was then discussed at considerable length by counsel, and the following were agreed to:—

"The undertakers shall not purchase or acquire the undertaking of or associate themselves with any other company or person supplying energy under any licence, provisional order, or special Act within the administrative county of London unless the undertakers are authorised by Parliament to do so.

"The accounts to be rendered by the undertakers under the 9th section of the principal Act shall be examined and audited from time to time by such competent and impartial person as the Board of Trade shall from time to time appoint, and the remuneration of the auditor shall be such as the Board of Trade shall from time to time direct, and the same and all expenses properly incurred by him in or about the execution of his duties shall be paid by the undertakers on demand in such manner as the Board of Trade from time to time direct, and shall be a debt due from the undertakers to the Crown, and shall be recoverable accordingly with costs.

"The undertaker shall give to the auditor, his clerks and assistants, access to such of the books and documents relating to the undertaking as shall be necessary for the purposes of the audit, and shall, when required, furnish to him and them all vouchers

and information requisite for such purpose, and shall afford to him and them all facilities for the proper execution of his and their duty.

"The Board of Trade may from time to time make and vary regulations prescribing the times at and the mode in which such audit shall be made and conducted, or otherwise, for the purpose of giving effect to the provisions of this section."

Upon the subject of laying mains under special agreement, the following new clause was submitted:—

"Twenty-eight days at the least before commencing to lay in any street any main which is intended for supplying electricity to any individual person or corporation, and not for the purposes of general supply, the undertakers shall serve upon the local authority and the occupier of each house which shall abut on so much of the street in which such main is to be laid as lies between the points of origin and termination of such main, a notice stating that it is intended to lay such main, and stating the name of the company by whom such main will be laid and the points of origin and termination of such main, and if within the said period any two or more of such occupiers shall require, in accordance with the provisions of this order, that a supply shall be given to the premises in his or their occupation, the necessary distributing main shall be laid by the undertakers at the same time as the main intended for such person or corporation."

Mr. GRAY took some exception to this clause, and contended that it needed some alteration so as to make it harmonise with the rest of the order.

Ultimately it was amended and agreed to as under:—

"Twenty-eight days at least before commencing to lay in any street any electric line which is intended for supplying energy to any particular consumer, and not for the purposes of general supply, the undertakers shall serve upon the local authority and the owner or occupier of premises abutting on so much of the street as lies between the point of origin and termination of the electric lines so to be laid, a notice stating that the undertakers intend to lay such electric line, and if within the said period any two or more such occupiers shall require, in accordance with the provisions of this order, that a supply shall be given to the premises in his or their occupation, the necessary distributing main shall be laid by the undertakers at the same time as the electric line intended for such particular consumer."

The new clause next considered contained provisions which, after discussion, were carried as follows:—

"Whenever the undertakers require to dig or sink any trench for laying down or constructing any new electric lines (other than service lines) or other works near to which any sewer, drain, watercourse, defence or work under the jurisdiction or control of the County Council or of any local authority, or any main, pipe, syphon or other work belonging to any gas or water company, or any branch or service pipe for the supply of gas or water has been lawfully placed, or where any gas or water company require to dig or sink any trench for laying down or constructing any new mains or pipes (other than service pipes), or other works near to which any lines or works of the undertakers have been lawfully placed, the undertakers, or such gas or water company (as the case may be) in this section referred to as the 'operators' shall, unless otherwise agreed between the parties interested, or in case of sudden emergency, give to the County Council or local authority, or to such gas or water company or to the undertakers (as the case may be) in this section referred to as the 'owners' not less than 14 days' notice before commencing to dig or sink such trench as aforesaid; and such owners shall be entitled by their officer to superintend the work, and the operators shall conform with such reasonable requirements as may from time to time be made by the owners or such officer for protecting from injury every such sewer, drain, watercourse, defence, pipe, electric line or work, and for securing access thereto; and they shall also, if required to do so by the owners thereof, repair any damage that may be done thereto.

"And where the operators find it necessary to undermine but not alter the position of any pipe, electric line or work, they shall temporarily support the same in position during the execution of such works, and on completion provide a suitable and proper foundation for the same where so undermined."

Mr. FREEMAN took exception to the next provision in the new clause on the ground that it was a very limited one, and did not cover all the rights and powers which the London County Council had under other parts of the order.

The provision Mr. Freeman objected to was:—

"The owners, upon giving notice to the undertakers during the 14 days hereinbefore referred to of their desire to execute any work to which the provisions of this section apply may themselves execute the same, and in case they give such notice they shall execute such work with due care and diligence, and shall be subject to the like restrictions and conditions as the operators would themselves be subject to in respect of the same, and the reasonable costs of executing such works shall be repaid by the operators to the owners: Provided always that the provisions of this paragraph shall not apply so long as any like notice from the County Council, the local authority, or other body or person under the provision of section 15 of this order remains in force."

Mr. FREEMAN said that for the last few lines he proposed to substitute the words:—"Provided always that the provisions of this paragraph shall not in any way affect or derogate from the provisions in this order contained for the protection of the County Council," &c. Such a provision, he said, could do no harm either to the gas or electric lighting Companies, it was only reasonable to have it inserted.

Mr. LOYD and M. BIDDER opposed the addition being substituted for that which had been agreed upon at the conference of the counsel.

The CHAIRMAN: What is it, Mr. Freeman, you really want?

Mr. FREEMAN: I want to save in this clause all my powers which are now scattered over the order. If the words which are put in by the electric companies stand by themselves they will lead to great difficulties, in our opinion it will cause a clashing of authorities.

After some further discussion, Mr. Freeman's proposal was rejected and the section as printed above agreed to, with this addition:—

"Provided always that when the undertakers or gas company desire to lay a service line or pipe to a house or premises already connected by a sevice line or pipe with works of the undertakers or gas company, as the case may be, 48 hours' notice shall be given by the undertakers or the gas company, as the case may be, to the other of them; and in that case the provisions of this section, in so far as applicable, shall then apply to such lines or pipes accordingly."

The remainder of the new clause evoked considerable discussion, the result being that it was altered and adopted in this form:—

"Whenever an electric line shall be laid down crossing or liable to touch gas mains, pipes or services the conductor carrying the electric current shall be effectively insulated in a manner approved by the Board of Trade. The undertakers shall not, except with the consent of the gas company, lay down any electric line so as to come into contact with any main or pipe of any gas company nor employ any mains or pipes of any gas company as conductors for the purpose of completing the electric circuit or for the conveyance of electric currents.

"Any question of difference which may arise under this section shall be determined by arbitration.

"If the operators make default in complying with any of the requirements or restrictions of this section they shall make full compensation to all owners affected thereby for any loss, damage, penalty, or costs which they may incur by reason thereof, and in addition thereto they shall be liable to a penalty not exceeding £10 for every such default, and in the case of a continuing offence to a further penalty not exceeding £5 for every day after the first day during which such default continues: provided that the operators shall not be subject to any such penalty if the Court having cognisance of the case shall be of opinion that the case was one of emergency and that the operators complied with the requirements and restrictions of this section so far as was reasonable under the circumstances, or that the default in question was due to the fact that the operators were ignorant of the position of the sewer, drain, watercourse, defence pipe, electric line, or work affected thereby, and that such ignorance was not owing to any negligence on the part of the operators.

"For the purposes of this section the expression 'gas or water company' shall include any body or person supplying gas or water."

With reference to crossing the bridges an additional clause, as under, was approved:—

"Notwithstanding anything herein contained, it shall not be lawful for the undertakers to break up or interfere with any bridge, or the approaches thereto, vested in the County Council, or the roadway or footway over the same, except in accordance with plans, sections, and particulars previously submitted to and approved in writing by the said Council, or as may be settled by arbitration as herein provided.

"If within 28 days after the submission of such plans, sections, and particulars to the said Council, with notice in writing requiring them to approve the same, the said Council shall disapprove or fail to approve such plans, sections, and particulars, then such plans, sections, and particulars shall be referred to an arbitrator to be appointed by the Board of Trade on the application of either the said Council or the undertakers.

"Such arbitrator shall consider and determine, having regard to the structure and design of the bridge, and to all other circumstances of the case, on what terms and conditions, and in accordance with what plans, sections, and particulars such crossings should be allowed, and the undertakers shall be bound to comply with and observe all the terms and conditions imposed, and the plans, sections, and particulars approved by such arbitrator."

The CLERK then read through the whole of the clauses, as amended, of the Bill (being the orders of the London Electric Supply Corporation), and they were confirmed.

The clauses of the Bills of the other companies were then rapidly gone through, and similar alterations and additions having been agreed to, the committee adjourned until Monday.

The Select Committee held a short and final sitting specially to consider the clauses of the Bill of the Metropolitan Electric Supply Company, Limited., under which power is given to light streets and other thoroughfares in Lambeth and Wandsworth in South; St. Giles's, Holborn, and the Strand in Mid; and Marylebone in West London. In reply to the Chairman (Sir George Trevelyan), the representative of the company stated that the Bill was practically a copy of the provisional orders which had been already settled. It was necessary, however, to make the Bill tally *ipsissima verba* with the orders. After a short consultation between the committee and the representatives of the Metropolitan Company, a number of verbal alterations were made, and the Bill thus amended was approved.

AMERICAN NOTES.

By DAS TELEPHON.

Mr. MITCHELL, the new Commissioner of Patents, is kept busy reviewing the decision of principal examiners, and scarcely a week passes that he does not reverse their decision, especially those made by Frank Brown, Principal Examiner in the Electrical Division. This Brown has been several times mentioned in these "Notes," as eminent for his total ignorance of electrical matters. The following decision was made by the Commissioner a few days ago.

Westinghouse is about to take another turn at litigation by suing all the electric light companies of the United States using the alternate current system, for taking advantage of the benefits of a patent of which he is the sole owner by right of a patent which was issued to-day. The patent in question covers very broadly the system of alternating current distribution, and it represents the fundamental patents of alternating currents and converter in multiple arc systems of distribution, and nearly all electric light companies, except the Edison Company, have used this system for years. The great advantage of the invention is to render the expenditure of power required in operating a plant to be at all times directly proportional to the amount of work done, and also causing the lamps to burn with the same brilliancy irrespective of the number of lamps. The invention was made by a Scotchman, Mr. Rankin Kennedy, of Glasgow, who wrote a number of articles about the advantages of his invention in an electrical paper in 1880*; but nobody seemed to take any notice of the matter, and Kennedy was frequently ridiculed. Mr. Westinghouse, however, who realised at once the great benefits of the invention, entered into negotiations with Mr. Kennedy, which culminated in the purchase of Mr. Kennedy's patent. This fact, however, has been kept a secret among the Westinghouse people, and while they have used the invention they never made any public claims. Now that the patent has been issued, Mr. Westinghouse intends to prosecute his claims, and proceedings will be entered against all the parties using the patent. The Thomson-Houston Electric Company, the Fort Wayne and Jenney, and the Brush Electric Company are all using the invention, and Mr. Westinghouse will enter suit against all of them either to-day or Saturday.

This invention is of the utmost importance to these companies, and if they lose the suit the financial loss will not only involve hundreds of thousands of dollars, but the companies will also lose the advantage of the invention and be forced to use another system more expensive and less practical.

Gas in the Subways.—Dr. Edward A. Martin, chemist of the Health Department, has made a report to the board in relation to the electrical subways in this city, in which he says that there are about 1,100 miles of gas mains in the city. The leaky joints and imperfections in these mains allow nearly 10 per cent. of the gas made to escape into the earth and air. Dr. Martin says:—"About 8,660,000,000 cubic feet of gas was made during the past year, 10 per cent. of which would be 866,000,000 cubic feet. A large amount of this leakage finds its way into the subways. Many of the complaints of gaseous odours in this city are, in my opinion, due to the gas escaping from the electrical subways. The danger of explosion, should the gas accumulated in the subways be ignited, is great." Dr. Martin recommends that the electrical subways be properly ventilated to prevent the dangerous accumulation of illuminating and other gases, but he does not suggest any definite plan for such ventilation. A copy of the report will be sent to the Board of Electrical Control.

The death penalty by electricity is creating a sensation in New York among electricians and self-styled electricians. Here are some of the statements made before the committee.

Councillor Charles H. Hatch, of Buffalo, has been trying very hard to avoid having William Kemmler, the murderer, made a practical test of the efficacy of the electrical apparatus supplied to the State by Expert Harold P. Brown, but he has no objections to serving himself as a subject for Mr. Brown's experiments, though he would probably draw the line at the full voltage of a Westinghouse alternating current dynamo.

Without a moment's hesitation the lawyer sat down on a chair in Edison's laboratory at Orange, N.J., calmly took off his shoes and stockings, and placed his left foot on a large zinc electrode covered with thick felt, while Electrician Wirt bound a towel around his neck and held on the top of his bald head an electrode measuring 4 by 6 inches, also covered with felt, and moistened with a solution of sulphate of zinc.

If Mr. Hatch had been a condemned murderer, I should not hesitate to say that he looked like a hardened guilty wretch as he sat there waiting for the shock that was to determine his resistance to electricity.

"Have you any dying requests to make?" asked Mr. Brown.

"No," was the stolid reply.

The eyes of a dozen men were fixed upon the lawyer as the full force of the current ran through his frame. There was a moment of breathless suspense. Then the electrician operating the Wheatstone bridge, after pulling one peg after another from the board in front of him until the deflection of the magnetic needle in the background showed that it had reached the proper point, exclaimed:—"The contact is not good. The resistance shown is 9,870 ohms."

With this result in mind, Mr. Hatch may safely be described as a tough subject. He looked up triumphantly at the expert and enquired:—"How many volts do you think it would take to kill me?"

"I'll guarantee to do it with 1,000," was the confident answer, and although Mr. Hatch looked incredulous, he did not ask to have the experiment tried. When he placed both of his bare feet on the lower electrode, his resistance was recorded at 8,170 ohms.

Dr. Frederick Peterson has not the slightest doubt that William Kemmler, the Buffalo murderer, could be instantaneously and painlessly killed by electricity. The doctor has made a special study of electricity, using it constantly in his practice in treating nervous and mental diseases. He took part in the experiments made last year upon dogs, horses, and calves at Edison's laboratory at Orange and at Columbia College, to determine the death dealing power of the electric current. The interesting results of his observations were spread upon the records of the Kemmler *habeas corpus* proceedings before Referee Tracy C. Becker.

He said emphatically that vivisection proved that lower animals could endure more severe attacks upon life than men. Operations upon the brain or intestinal canal that would almost invariably result in the death of a man usually had no serious consequences upon dogs. The best authorities agree that the nerves carry sensations about 90 feet a second—infinitely less velocity than the electric current shows.

"Can an electric current be produced by artificial means, in your opinion, and be so applied to a human being as to cause death in every case?" asked Assistant Attorney-General Poste.

"I think so," replied the physician.

"And do you think that death could be caused in every case instantly and without pain?"

"Yes, sir."

Dr. Peterson thought that if the electrodes were properly arranged there would be no danger of any burning. If they were applied to the head and feet of the criminal, as proposed, the current would diffuse itself throughout all the tissues of the body inside of the skin. He did not think it was possible for the current to fail to strike a vital part. He said he considered the effect of the alternating current twice as great as that of the continuous current.

Under cross-examination by Counsellor Hatch the doctor said he was satisfied of the death of the dogs upon which experiments had been made, as they had ceased to breathe—a certain sign of death if continued for any length of time. Death was also evidenced by the ceasing of the beats of the left ventricle of the heart. He declared that for his part he declined to believe in the possibility that men could show every sign of death and lie for days apparently dead before reviving. There was no doubt that the dogs operated upon were dead, though for 36 minutes after one of the bodies had been cut open the auricle of the heart continued to beat. This was due to nervous ganglia, and was by no means unusual. Dogs' hearts sometimes beat for half a day after they have been removed from their bodies. Rabbits' hearts often beat for ten hours, and those of frogs and turtles for ten days under the same conditions. The idea that any of the dogs were merely suffering from suspended animation never occurred to him, and he made no efforts to restore any of them to life. He dissected some of the bodies and examined sections of the viscera and muscles under the microscope. He found that the blood was unusually dark and that some of the capillary vessels in the nerves had been broken. The dogs that exhibited pain when they first received shocks were those upon which experimental currents were tried. Just why death results from electricity and why the heart stops nobody knows.

John H. Noble, a young man in the employ of the Westinghouse Company, followed Dr. Peterson on the witness stand. About fifteen months ago, he said, he was fixing a safety catch in Denver, when he slipped and both of his hands came into contact with the wires of an alternating current machine having a pressure of over 1,000 volts. He jumped back and escaped with bad burns. He was very nervous for some hours afterward, and he could not entirely get rid of the unpleasant feeling for three weeks. He declared that he did not know of any electric current that was absolutely certain to cause death.

Francis W. Jones, assistant general manager and electrician of the Postal Telegraph and Cable Company and general manager of the United Lines Company, was asked to describe a number of experiments he had made in testing on the Wheatstone bridge the electrical resistance of different men. He began by measuring himself, and the first test on a one cell battery, with one finger of each hand on an electrode, showed 80,000 ohms resistance. He increased the battery to ten cells and found his resistance reduced to 37,000 ohms. Other tests that he made upon himself on the same day showed variations of from 16,000 to 36,500 ohms. With a two-cell battery and electrodes on his head and at the back of his neck his resistance was recorded at 31,000 ohms. By taking the electrode from his head and placing it under his fifth rib the resistance changed to 26,000. Repeating the experiment with five cells, the first position showed 11,000 and the second 8,100 ohms, and a few minutes later the bridge marked less than one-half of this resistance. He made similar tests on a number of different subjects with widely varying results.

What Mr. Jones has read about Mr. Brown's experiments upon dogs has raised the doubt in his mind whether any particular electrical current can be relied upon to kill. Mr. Brown in his own published report showed that he had killed one dog in 15 seconds with 106 milliamperes of a continuous current, but had failed to kill another dog with 140 milliamperes alternating current. The

* This is doubtless meant for the ELECTRICAL REVIEW, and the date should be 1883.—EDS. ELEC. REV.

dogs operated upon by Mr. Brown varied in resistance from 2,600 to 36,500 ohms; while a dog that was twice tested by electrician Kennelly showed a resistance of 200,000 ohms.

The number of volts necessary to kill a man depends upon his resistance, and that is affected by hot and cold weather, and it may be materially increased if his blood has become impoverished and contains less than the usual quantities of salt and iron. The saline fluids of the body are good conductors, but the flesh, fibres and bones of themselves are non-conductors.

Alexander McAdie, who described himself as a student of atmospheric electricity and an expert in lightning, was the next witness. He said the general effect of a current such as was proposed to be used on Kemmler would be unconsciousness, rupture of the corticle cells of the cerebrum, paralysis of the nerves and muscles, suspense of respiration and then suspense of circulation. He thought, however, that it was a serious question whether or not the current would kill, as the physical resistance of man differs materially. Then there is a possibility that the current would pass entirely on one side of a man's body, causing absolute paralysis of that side, but perhaps not killing him. If the current were continued and the sponges at the end of the metal electrodes became dry, carbonisation of the body would result. It was possible that a man might be burned even with the sponges wet. He cited the case of a woman who had been struck by lightning and who was thought to be dead for some time, but who was revived under medical treatment. English medical journals, he said, had reported the case of a man struck by lightning and thought to be dead, who was given medical aid 24 hours later and revived. In experiments made abroad a rabbit was placed before a machine that could throw a spark 29 inches. This spark flew around the animal without killing him.

Mr. McAdie does not think that the tests made upon animals form any criterion upon which to base a calculation of the effects of electrical shocks upon men.

"What, in your opinion, would be the effect of an electric current applied to a criminal in the manner which it is proposed to try it?" asked Mr. Cockran.

"Well," the witness responded, halting through his answer, "it is a question whether it would kill or not. Its deadly effect would depend upon the subject's resistance and upon the route through the body which the current took. It might only paralyse one half of his body and leave the other half unharmed. The route taken by the current would largely depend upon the subject's physical condition."

"Does it follow that because an electric current is sent into a man it will pass through any vital spot?"

"Not at all. It might kill him, and if it didn't kill him instantly it might carbonise him—burn him up."

The moistened sponges which it is proposed to use in the death chair to lessen the heat at the point of contact, the witness said, would not inevitably prevent the burning of the flesh. The current might burn up the sponges too.

"If the sponges were kept wet and the current were kept up, as the law provides, until the subject is dead, would it burn the man up, provided it did not kill him at first?"

"Yes, I think it would char his flesh," the witness responded, and Mr. Brown and other experts present laughed quietly at the reply.

He did not think that any safe conclusion could be drawn from experiments on animals as to the effect of electricity upon human beings or as to the electromotive force which would inevitably kill. There is no known means of generating a current which would always kill.

"That is," he added, "when we deal with electricity we are not sure of anything. We have no means of knowing whether a man who has been killed by electricity was killed instantly or not, or painlessly. We don't know how it kills; we simply know that the man is dead."

Mr. Poste then cross-examined Mr. McAdie at considerable length. He asked the witness some questions about books which he had read, and the witness seemed to experience a good deal of difficulty in replying. Mr. Poste enumerated several works by standard authors which Mr. McAdie had never read, and finally he admitted that he had never read any book upon the effect of lightning upon human beings, and had never observed the effect of a stroke of lightning upon a human being. He was asked as to his opinion of the works of Silvanus Thompson and other writers upon electrical subjects, and said that he would prefer not to express an opinion, his manner conveying the impression that he regarded Mr. Thompson and the others as of no account, but he would not wound their tender natures by saying so out loud. Mr. McAdie was then further questioned concerning his right to testify as an expert, questions which he did not answer in a very satisfactory manner, and a recess of half an hour was taken.

When the gentlemen reassembled at 2 o'clock they found a splendid looking dog in the room. He was a big fellow, a cross between a Scotch collie and a St. Bernard, and his legs were done up in bandages. He was introduced as Dash, the dog which had been revived after it was supposed that he had been killed by an electric shock. Charles Tupper, an excitable gentleman, who keeps a restaurant at 226 Eighth Avenue, is the dog's owner, and he told of the animal's experience. On July 3rd, he said, the dog stepped upon a telegraph wire lying on the ground which had been crossed by an electric light wire. He jumped about four feet in the air and fell back upon the wire, where he lay for several minutes. When he was taken off he was, as far as anybody could see, absolutely dead. Somebody suggested that if the body were buried the earth might draw out the electricity from the dog's body. He tried the experiment, half buried his dog in loose earth, and watched the result. In a few hours the animal began to show signs of life, and he kept on getting better and better until, barring the wounds on his nose and legs, which were rapidly healing, he was as well as ever.

This Mr. McAdie is employed by the Bell Telephone Company of Boston as a detective, hence his high opinion of Prof. Silvanus P. Thompson.

In the hearing before the referee of the Kemmler electrical execution case, Thomas A. Edison was put on the stand as a witness, and if his testimony were to decide the fate of Kemmler, the murderer would surely meet his death in the electrical chair. The witness had no doubt whatever of the power of an alternating current to kill a man instantaneously and painlessly, and was sure it could be done without burning. The case of Mr. Smith was spoken of, who was said to have received a shock of 1,500 volts without serious injury. Mr. Edison said he would pay Mr. Smith $100 if he would come over to his laboratory and successfully withstand a shock of 1,000 volts.

During the examination the following interesting dialogue occurred between the Wizard and the ex-Congressman with the big head, who is trying to save Kemmler:—

"Now, Mr. Edison," asked Mr. Cockran, "suppose I was to give you a lump of clay containing a number of metals, and asked you to measure the resistance of the clay, could you do it?"

"Yes; I would simply give the resistance of the moisture, as the clay is a non-conductor."

"Well," said Cockran, "you would be then giving me the resistance of the metal moisture, as well as that of the clay. Cannot you measure the clay alone?"

"I think that question is nonsense," Mr. Edison replied, after thinking a moment or two. "I would give the resistance of the whole thing."

"This obtaining of the resistance of the human body by the Wheatstone bridge is simply a matter of late experiment, is it not?"

"No; I measured human resistance by the Wheatstone before the question of electrical execution was brought. I consider the bridge as an accurate means of measurements."

"Mr. Pope, an expert we had here to testify," continued Mr. Cockran, "said that a man could be completely carbonised by an electric current. Is that so?"

"Yes; but it would take 1,500 horse-power to do it."

Q. If you took the Westinghouse current of 1,050 volts and kept it applied to a human being five or six minutes, wouldn't it be carbonised?"

A. "No; it would be mummified."

"Ah!" said Mr. Cockran, "no possibilities arise. He wouldn't be carbonised, but mummified, eh? Let us hear how, Mr. Edison."

Mr. Edison: The water or moisture in his system would be gradually absorbed.

Q. What current would be necessary to kill Kemmler? You said 1,000 volts. Does that mean anything? Couldn't you give a man this shock so as not to be fatal?

Mr. Edison: What! An alternating current?

Mr. Cockran: Any one. How many ampères would be required?

A. I think one ampère would be ten times too much.

"You mean to say," asked Mr. Cockran, "that if a man wanted more than one-tenth of an ampère he would be mean and rapacious?"

"Yes," answered Mr. Edison, amid much laughter.

Another witness was Dr. Cyrus Edson, of the Board of Health, who conducted the experiments made by Harold P. Brown lately. The doctor said that all the dogs experimented upon, except one, were killed instantly by the alternating current. There was no question about it, the dogs were dead, and not just knocked senseless, as Mr. Cockran seemed to believe. Some other questions were asked the witness about these experiments, and then Mr. Poste put his usual question:

"Do you believe that an electric current can be artificially generated which will inevitably kill in every case when scientifically applied—kill instantly and without pain?"

"I have not the faintest doubt of it," Dr. Edson replied with much emphasis.

Mr. Cockran then took the witness suavely in hand, and asked him if he did not consider the science of electricity to be still in the experimental stage. It could not be called an exact science, Dr. Edson said, but there were many things in it which had become demonstrated facts. Mr. Cockran, in his playful, inquiring way, expressed a desire to know one of those facts, and the witness promptly replied: "We know that electricity can kill."

"How do you know that?" asked Mr. Cockran.

"We know it from experiments on animals, and we can reason that if electricity will kill an animal it will kill a man. And electricity has killed many men, as you know."

The witness was then questioned as to Dr. Petersen's assertion that one auricle of an animal's heart might continue to beat after the animal's death. He said that it might, but not with the rhythm of the heart of a live animal. The witness said he had no difficulty in believing that a man might be struck by lightning and not be killed, but he could not believe, in such a case, that the whole force of the charge had been sent into the man's body.

Rudolph A. Witthaus, Professor of Physics and Chemistry in the University of the City of New York, succeeded Dr. Edson in the witness chair. He had devoted a considerable amount of time to the study of electric currents. Dr. Sachs had a day or so before testified that in his opinion an electric current such as it is pro-

posed to try on the Buffalo murderer would burn the subject woefully. His testimony was read to the witness, and he differed from Dr. Sachs absolutely. Where the contact made was perfect burning would be impossible, and Mr. Witthaus went on to explain just why it would be impossible. His explanation was such a purely technical one that even Mr. Cockran, with his vast knowledge of technicalities, could not understand it, and the witness was permitted to go un-cross-examined.

EXPERIENCES OF SEVERAL MEN WHO SURVIVED SHOCKS OF ELECTRICITY.

They were Too Tough to Kill.

The Current to be used on Murderers Not as Strong as They Received.

Ajax defying the lightning would have cut a sorry figure beside some of the men who related their experiences before Referee Tracy C. Becker. There was one witness who had received a stroke of lightning and had felt the static current playing all around his body. Another salamander had on several different occasions the full electromotive force of powerful alternating and continuous current dynamos whizzing through his veins without sustaining any permanent injury. The voltage in some instances was nearly half as great again as that of the machine upon which it is proposed to execute William Kemmler. This witness was succeeded by others with almost equally startling tales to tell, all going to show that while electricity may kill with promptness and despatch it is by no means certain of doing so.

Mr. Alfred West, of No. 441, West Forty-seventh Street, was the original Ajax of the day. He was spending the summer at Fort Lee, N.J., a few years ago, he said. One bright morning he started off for a walk along the Palisades. A storm came up, and he sought shelter under a large tree. There was a terrific clap of thunder, and then Mr. West sank peacefully down to the ground. As soon as he was in condition to investigate he found that the bolt had entered his clothing at the top button of his waistcoat, passed through his shirt and undershirt and then blazed its way down his body to his right leg, through his right shoe and then jumped over to his left leg and twisted around the calf until it got tired and left. What remained of his clothes was scarcely worth speaking of, not much more than sculptors give to their statues of Ajax. He was carried to his hotel and revived. He suffered considerably for a couple of weeks, but recovered fully after that. At first he had a wide mark on his breast and a network of little lines. The only permanent scars are three small spots above his right ankle.

T. Carpenter Smith looked strong enough to resist almost anything. He is a great big fellow, about 6 feet 2 inches tall and of massive proportions. His age is under thirty-three years. The first shock he described was received from just such a machine as is expected to kill Kemmler—a Westinghouse No. 1 with a power of 1,050 volts and 35 ampères. He unintentionally took the full current through his hands and promptly dropped to the floor. He felt as if the filling had been knocked out of his teeth and as if he had been scourged all over with a bundle of loose steel rods. He was not very badly hurt, however, as he was able to jump up and turn on the lights that he had extinguished. He continued with his work, though he felt very stupid for half an hour. His hands were slightly burned, but not enough to trouble him very much.

In Mr. Smith's opinion, a 1,000 volt shock from an alternating current machine is not enough to trouble a man very much under any ordinary circumstances. The men employed around Westinghouse machines receive the current from time to time and usually relieve their overcharged feelings afterward by the use of glowing profanity, but they do not die except at rare intervals. Mr. Smith got a second one of the presumably death-dealing shocks at the works of the Alleghany County Light Company, in Pittsburg, and he spoke of it as a mere trifle. He also dallied for a moment with an old Westinghouse No. 3 machine, with a voltage of 1,000 and a capacity of 125 ampères, giving nearly three times the force the State calculates will kill. As a usual thing electricity knocked Mr. Smith down when it struck him, but he always came up smiling for the next round. Once a man rushed up to him and enquired, "Are you killed?"

"No," replied the electrician, "but I feel like it." On that particular occasion he found that he had two little rows of holes in the soles of his feet just over where the nails were in his shoes.

Dr. Alfred L. Loomis, of No. 19, West Thirty-fourth Street, testified that he knew of no electric current that would kill absolutely, instantly and painlessly in every instance.

Benjamin D. Acker, who is the employ of the Keystone Light and Power Company, of Philadelphia, said he had received several powerful shocks himself. He knew that a man named William M. Wright had received the full current from a 1,000-volt alternating machine for a period of seven or eight minutes. Wright's face became purple, and it was thought at first that he was dead, as there were no signs of life and no breathing could be detected. He was revived, however, and he suffered a great deal. Although there was no burn on the surface his flesh along his arm was badly burned under the skin, and two or three days later it began to fester.

Dr. Rockwell, who has had 25 years' experience, made the following statements:—

Mr. Poste went over the testimony of Dr. Sachs. "It is stated," said the lawyer, "that the resistance of the human body under application of electric currents reaches a point between 1,200 and 1,400 ohms. How can the resistance of the human body be reduced?"

"By increasing the size of the electrodes the resistance of the human body is very materially decreased."

This was a point in favour of the State. Mr. Poste followed it up by calling the attention of the witness to the experiments on various resistances.

"I feel certain," said Dr. Rockwell, "that the same electrical effect could be produced on every human being in the careful application of the current. I was present when Mr. Harold P. Brown experimented on animals at Mr. Edison's laboratory. Four dogs, one horse and four calves were operated upon. Death was instantaneous in every case except one, and that was a dog."

Mr. Bourke Cockran quietly remarked that that must have been a very sad dog indeed.

The witness went on to say that a human being could be painlessly and instantaneously killed without the flesh being burned. He was told to describe how the current would act.

"In the case of a man," he said, "in a recumbent position, with one electrode placed at the base of the skull and the other at the feet, the current would follow the course of least resistance."

"And what is that course?"

"That would be determined by the condition and temperature of the subject."

Mr. Cockran brightened up at the last answer, and he afterward said that was the whole point at issue, for no two human beings were alike in those conditions. In his next answer, however, Dr. Rockwell said he would be very much surprised if 1,000 volts did not kill in every case. "I have no doubt whatever," he added, "that 1,500 volts would kill instantaneously. The current would follow the line of least resistance—that is, the muscles and blood vessels, as these are the most saline points of the body. In my opinion the pathological effect of a charge of 1,000 volts would be to paralyse the nerve centres, rupture the tissues, and instantly stop the action of the heart and respiration."

"What is electricity?"

"I don't know, and I don't think anybody else knows. It is an unknown agent, and it is not known even if a current exists."

This last statement by Dr. Rockwell is about the most sensible thing said by any of the *famous!!* scientists who have testified on this subject.

At a meeting of directors of the New-England Telephone and Telegraph Company, a dividend of 75 cents per share was declared, payable August 15th. The net earnings of the company for the quarter ending June 30th, 1389, were $93,814; surplus, $75,858, showing an increase in net earnings over the corresponding period last year of $489, and an increase of surplus of $8,814.

The Edison Company offers to supply electric lights after October 1st at the equivalent of $1.50 per thousand cubic feet of gas, the price now charged by the city.

The Thomson-Houston European Electric Welding Company has been organised in Boston by the election of the following-named gentlemen as directors: Oliver Ames, S. Endicott Peabody, B. F. Spinney, J. W. Smith, W. O. Boland, Charlton T. Lewis, S. O. Van Hoffmand, S. B. Babcock, and Henry D. Hyde. Oliver Ames was chosen President and W. A. Boland Treasurer. The capital stock is $1,500,000.

The Postmaster-General gives out the following concerning the report that he made an order reducing the rate on Government telegrams from one cent to one mill per word. He says that he had suggested this rate and notified the telegraph companies to this effect. To some of the companies objecting to the rate he had written a letter which stated, among other things:—"I desire to say that the rate proposed was fixed upon information furnished to this department that your company has been making rates to various large corporations that are, in some instances, as low as the figure now proposed for the Government service. With the notice of this fact I would not be justified in making for the Government a new contract at higher rates than were charged other patrons, especially so in view of privileges and benefits extended to your company by Acts of Congress. I submit to your own sense of right that the Government under existing conditions is entitled to the minimum rates."

One more Conduit Bursts.—A thin dazzling streak of fire darted from the pavement on the corner of Twentieth Street and Broadway about half-past 7 o'clock on the evening of the 25th. A moment later a sound like the breaking of a thunder bolt shook the air, and before you could say "Jack Robinson," two tons of cobble stones, each weighing about 10 lbs., were shot 20 feet into the air, falling promiscuously within a space of 20 square feet.

Strangers who happened to be in the neighbourhood imagined a live volcano had broken loose on Broadway, but this was an exaggeration. It was merely another case where the electric subways refused to hold the pent up gases that find their way into them, and, having no natural way for getting out, expand, blow up 20 or 30 square feet of good American soil, and make things generally lively for people who are compelled to live in a loaded neighbourhood.

Baltimore, *July 19th and 26th.*

THE PROPOSED DIRECT CABLE FROM HONGKONG TO SINGAPORE.*

THE following official correspondence on this subject has been handed to us for publication by the Secretary of the Chamber of Commerce:—

* Hongkong *Daily Press.*

THE MANAGER OF THE EASTERN EXTENSION TELEGRAPH CO. TO THE COLONIAL SECRETARY.

Hongkong, *6th April*, 1889.

Sir,—I have the honour to state the following for the information of His Excellency the Governor :—

It will be within His Excellency's recollection that in 1885, 1886, and 1888, the question of a cable from Hongkong to Singapore, not touching on foreign territory, was considered by this Government, without, however, any definite decision being taken.

I am now instructed by my directors to inform His Excellency that the authorities of British North Borneo have addressed them with a view to the extension of our system to that place by means of a cable from Singapore to British North Borneo, touching *en route* at Labuan and Sarawak.

Should this arrangement be carried out, an opportunity would be afforded, by continuing the new cable from North Borneo to Hongkong, of giving this colony direct communication with that rapidly developing country, and at the same time providing that alternative route to Singapore, touching only on British territory, which has been so generally recognised as politically and strategically important.

I would point out that the existing cables are amply sufficient to carry a considerable increase of the present traffic, and as the additional traffic due to the establishment of the proposed new cable would be entirely insignificant in proportion to the large outlay, my directors instruct me to state that the extension could only be carried out in consideration of the undertaking being subsidised by the Governments interested.

I would mention that the subsidies named in my letter of April 14th, 1888, were for a duration of 20 years, that being the period upon which all our actuarial calculations are based, and I am now instructed to enquire whether the Government of Hongkong would be disposed to grant a subsidy for 20 years for this purpose, and, if so, of what amount?

As I gather that one of the objections taken by the Chamber of Commerce to our former proposals was that the advantages were purely political, I would now beg to point out that the present proposition, if carried into effect, would subserve both political and commercial interests.—I have, &c.,

WALTER JUDD, *Manager in China,*
Eastern Extension, Australasia, and China Telegraph Company, Limited.

The Hon. F. Stewart, LL.D., Colonial Secretary.

THE COLONIAL SECRETARY TO THE CHAMBER OF COMMERCE.

Colonial Secretary's Office,
Hongkong, *12th April*, 1889.

Sir,—Adverting to previous correspondence, I am directed by His Excellency the Governor to transmit to you, for the consideration of the Chamber of Commerce, the enclosed copy of a letter from the manager in China of the Eastern Extension, Australasian and China Telegraph Company, Limited, and the Great Northern Telegraph Company of Copenhagen on the subject of a proposed direct telegraphic communication with Singapore; and to state that the offer now made differs from the previous one inasmuch as having all the advantages offered by the latter, it includes also that of communication with an island of rapidly growing importance, in which Hongkong is likely to have special interest.

I am to add that His Excellency Admiral Sir Nowell Salmon has, since the date of the last correspondence with the Chamber, impressed on the Governor the great importance of a second line of communication with Singapore, being of opinion that, even if the line were cut after a declaration of war, the passage over it of a single message to the effect that war was imminent, might be worth to this colony more than the whole of any subsidy that has ever been asked.

Sir Nowell Salmon is also of opinion that in case of war the line *via* Borneo would be of special value as being near the route of the trade between China and Australia.

Under the circumstances His Excellency the Governor would be glad to receive the views of the Chamber on Mr. Judd's communication.—I have, &c.,

FREDERICK STEWART, *Colonial Secretary.*

To the Secretary, the Hongkong General Chamber of Commerce.

THE CHAMBER OF COMMERCE TO THE COLONIAL SECRETARY.

Hong-Kong General Chamber of Commerce, Hong-Kong,
May 11th, 1889.

Sir,—On the 17th April I had the honour to acknowledge receipt of your communication of 12 idem handing copy of a letter from Mr. Walter Judd, manager in China of the Eastern Extension, Australasia, and China Telegraph Company, being in continuation of previous correspondence from that gentleman, and having reference to a proposed special cable between this colony and Singapore.

Since the date of my letter, as above, the subject of telegraphic communication with Singapore, has again received careful consideration at the hands of the Committee of this Chamber, and I am directed to state for the information of his Excellency the Governor that though circumstances have somewhat altered since the 31st July, 1888, when they had last the pleasure of addressing you on the same subject, they do not consider the changes are in themselves of sufficient importance to necessitate any modification of the views then expressed.

The suggested connection of the proposed cable with the promising territory which British North Borneo has now become is no doubt a factor of very considerable commercial importance, but the committee are not of opinion that it in any way lessens the obligation attaching to the Imperial Government to do all in its power to increase the effectiveness of two such important coaling stations as Singapore and Hongkong.

These views are strengthened by the fact that the Home authorities readily admit the necessity for complete effectiveness at eastern coaling stations, and the committee of this Chamber therefore still deprecate the appropriation of any portion of the colony's revenue to subsidising a special cable.—I have, &c.,

F. HENDERSON, *Secretary.*

Hon. F. Stewart, LL.D., Colonial Secretary.

NEW PATENTS—1889.

11999. "Improvements in electric meters." W. EMMOTT and W. ACKROYD. Dated July 29.

12035. "Improvements in electric meters and electric regulators." G. FORBES. Dated July 29.

12046. "Improved composition adapted to electric insulators and other articles and uses in the arts and manufactures." F. MARQUARD. Dated July 30.

12047. "A mode of rendering the knobs or buttons of electric bells, electric switches, and such like, luminous in the dark." Hon. F. D. LEIGH. Dated July 30.

12066. "An electric hand signalling lamp." T. W. WATSON and A. H. WATSON. Dated July 30.

12082. "Improvements in the arrangement and regulation of electric motors for traction, marine propulsion, and like purposes." A. J. JARMAN. Dated July 30. (*Complete.*)

12135. "Improvements in electric cut-outs, and apparatus for opening electric circuits." W. E. HEYS. (Communicated by N. Chaize and J. Chaize, France.) Dated July 31.

12145. "Improvements in generating electricity or magnetism by the application of heat." P. M. JUSTICE. (Communicated by E. G. Acheson, United States.) Dated July 31. (*Complete.*)

12161. "Electric alarm rug or mat." J. J. PERKINS. Dated July 31.

12185. "An improved mode of distributing electricity." A. H. HOWARD. Dated July 31.

12188. "Improvements in apparatus for regulating and utilising electric currents." H. H. LAKE. (Communicated by F. M. Maquaire, France.) Dated July 31.

12236. "Improvements in appliances for the generation, distribution, measurement, and use of alternating or commutated electric currents." J. SWINBURNE. Dated August 1.

12251. "Improvements in electric couplers." I. A. TIMMIS. Dated August 2.

12270. "Improvements in apparatus for electrical sight and sound signalling on railways and in mines and coal pits." H. J. PEDDIE. Dated August 2.

12286. "An electric current meter." Sir C. S. FORBES, Bart. Dated August 2.

12313. "Improvements in apparatus for regulating and maintaining constant or nearly constant the electromotive force in electric conductors." H. LEA. Dated August 2.

12331. "Improvements in self-adjusting electric pendulum indicators." F. KING and W. P. MENDHAM. Dated August 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1888.

9745. "An improved system for driving moving electric motors or locomotives in series." E. MANVILLE. Dated July 4. 8d. Claims :—1. In a system of traction by electricity, the arrangement of the main conductor in alternate zigzag sectional parts overlapping one another, so that a part of each sectional conductor lies parallel to a part of the sectional conductors immediately preceding and following it, the connection being made by contact boxes to place the said parallel conductors in series, substituted for by the motor as it passes, substantially as and for the purposes described. 2. In such a system of traction by electricity, the relative diagonal disposition of the breaks between sections to the construction and length of the rubber contacts carried by the locomotive, so as to effect its passage from section to section without break or difference of potential, other than that due to the motor in the various sectional parts of the conductors, substantially as described. 3. In such a system of traction by electricity, the adaption of warning signals to the opening and closing apparatus, whereby the driver of any car or locomotive may have due notice as to the position of the preceding car or train, substantially as described.

11100. "Improvements in permanent ways for vehicles propelled by electricity." J. KINCAID. Dated July 31. 8d. The

main object of the invention is to provide a permanent way wherein the parts are more readily accessible and renewable than hitherto, and the rails and conduits for which are more conveniently and economically made than is the case with such conduits as hitherto formed or constructed. 7 claims.

11106. "Improvements in electrical signalling apparatus." H. H. LAKE. (Communicated from abroad by E. Davis and E. B. Welch, both of America.) Dated July 31. 11d. Relates more particularly to contrivances of that kind designed for use in police street signal boxes, and in similar places for the purpose of giving signals or alarms. The object of the invention is to provide an apparatus which shall be capable of giving certain common signals or alarms, such as a signal indicating the number of the box in which the operator may be calling an ambulance, giving an alarm of fire, calling to the telephone, or the like, and also an individual or particular signal which shall indicate the particular officer, watchman or person making the signal. 10 claims.

11570. "Improvements in electric arc lamps." H. PIEPER. Dated August 10. 8d. Consists in the application of the difference between the speeds of rotation of two moving bodies rotating in the same direction to produce the advance of feed motions and regulate the relative positions of the carbons in arc lamps, the said difference being dependent on or produced in any suitable manner by variations in the current. 2 claims.

11573. "Improvements in electric lamps." H. H. HEAD and L. SAUNDERSON. Dated August 10. 4d. Claim:—Impregnating or mixing the carbons of electric lamps with colouring matters.

12163. "Improved cell or containing vessel for electric batteries." H. G. C. SERRIN. Dated August 23. 11d. Claims:—1. A cell or containing vessel for an electric battery, made of a block of wood or of equivalent material without joints. 2. In a cell or containing vessel of the kind referred to in the previous claim, the arrangement consisting in totally enclosing the elements in a block in such a way as to enable the apparatus to be placed in a special box, and applied to such purposes as the lighting of a lamp, the illumination of a watch, or the operation of a bell, the whole substantially as described and for the purpose specified.

12289. "Improvements in electric propulsion on railways." S. Z. DE FERRANTI. Dated August 25. 8d. The inventor supplies the propelling current to the motor on the train for the most part by means of insulated conductors laid along the line; but to enable the train to pass over spaces where the insulated conductors are not laid, or where from any cause they are not supplied with current, he carries also secondary batteries on the train. He feeds these secondary batteries from the insulated conductors on the line. Where these conductors are supplied with continuous current, the secondary batteries are either fed from them directly, or through a converter which suitably adjusts the electromotive force. 6 claims.

12452. "Improvements in electrical locomotives or traction engines." A. SANDRON. Dated August 29. 6d. Two beams or girders, one on each side, constitute the frame for the dynamo and the support for all parts requiring a fixed and rigid support. To these beams are fixed the axle boxes by means of lugs or projections formed on the axle boxes and engaging in seats or sockets rivetted to the said beams. The dynamo is placed between the two axles of the vehicle, and carries on its axle two pinions which communicate their movement to the axles of the vehicle by means of spur wheels mounted thereon. The said pinions are provided on each side of their bosses with conical cups, the inner ones of which engage with fixed cones keyed to the axle of the dynamo, while the outer cups engage with cones which slide longitudinally on the axle, but turn with it. These latter cones are under the influence of springs by means of rods acting on cross-pieces arranged or placed in slots formed in the axle of the dynamo. 1 claim.

13215. "An improvement in electrical batteries." W. CLARK. (A communication from abroad by L. Maiche, of Paris.) Dated September 12. 4d. Claim:—The employment of citrate of ammonia dissolved in water as an electrolytic exciting agent for galvanic batteries, and especially those intended for continuous use, as specified.

13987. "Improvement in electric arc lighting." L. SAUNDERSON. Dated September 28. 6d. The electrodes are either made hollow or they have small gas burners close to the arc flame, so as to feed the flame with either coal or mineral oil gas. The hollow electrodes also can be partially filled with solid petroleum or with vaseline, which is vaporised by the heated electrodes, and thus feeding the flame with petroleum vapour. 4 claims.

15648. "Improvements in electric switches." W. B. CLEVELAND. Dated October 30. 8d. The invention consists, broadly speaking, in combining together a primary actuating device, a movable contact bar, and a spring connected respectively with said two parts; said primary actuating device having a range of movement wherein the line of said two spring connected points may pass respectively to opposite sides of the dead centre line of the spring movement; the spring being under compression or tension between the primary actuating device and the contact bar, thereby throwing the latter in a quick movement either to open or closed position, accordingly as the line of spring power may be shifted to one side or the other of said dead centre line. 5 claims.

CORRESPONDENCE.

Alternate Current Working.

In the issue of the 2nd inst. of your esteemed journal I am reading a reproduction of Mr. Mordey's reply to the discussion on his paper, "Alternate Current Working," in which he quotes two statements from my writings for the sake of demonstrating some contradiction between them.

To this I beg leave to oppose that, in fact, there does not exist any contradiction at all. By saying "We state that we have not reduced the periodicity because of the coupling in parallel," I purposed only to declare that we absolutely have *not reduced* the periodicity—*as, indeed, there did not exist any necessity at all for us to reduce it.* I have observed the periodicity of 42, or nearly so, in my dynamos at a time when the idea of running alternating machines parallel was still unknown, because the necessity of such a coupling was not recognised until after the invention of the transformer system. The experiments we made with coupling in parallel afterwards showed that the periodicity above mentioned proves advantageous, among other things *for the coupling in parallel* of my machines. Now, nothing was more natural for me than to preserve this periodicity, the further advantages of which became already notorious from the experience of a period when of Mr. Mordey's respective working nothing had yet received publicity.

As for our silence on the particulars of our alternate current motor we fully agree with Mr. Mordey's opinion that there are no doubt good and sufficient reasons for this reticence.

Chas. Zipernowsky.

Buda-Pest, *August 7th*, 1889.

Cheap Telegraphy.

The Editors of the *Journal des Economistes*, in the number I have the honour of forwarding herewith, gave me great satisfaction by granting space to the scheme of a telegraph system which I still consider as being the best means of affording a greater relief to the public, not only without injury to the revenue, but even with an enlargement of receipts.

I need not point out that, when adopted in the service of the United Kingdom, such a regulation, while leading to a lowering of rates for those telegrams which do not require all possible speed, could bring into perspective the *threepenny rate*, at least for a part of the correspondence, as I aimed at in my writing which was kindly taken up in your issue of March 30th, 1888.

Linckens.

The Hague, *July 30th*, 1889.

[The article to which M. Linckens alludes may be found in our other columns.—EDS. ELEC. REV.]

American Patents.

We have just received the following cablegram from Mr. George Westinghouse, jun., of Pittsburgh, U.S.A., the contents of which may interest your readers:—

"Decision yesterday Judge Wallace in United States Court, in case conducted by Edison Company, construing Supreme Court decision holds American patent expires with prior patent abroad, even when void for failure to work or pay taxes. This decision overthrows high resistance carbon filament patent, main reliance of Edison Company for maintaining monopoly incandescent lighting in United States."

J. E. Pickering, *Secretary,*

THE NATIONAL COMPANY FOR THE DISTRIBUTION OF ELECTRICITY BY SECONDARY GENERATORS, LIMITED.

August 10th, 1889.